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THE DOMAIN OF THE GROUND EFFECT MACHINE

APPENDICES

Volume II

Prepared for
Office of Naval Research
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August 1961

BOOZ·ALLEN APPLIED RESEARCH, INC.
CHICAGO
WASHINGTON

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TABLE OF CONTENTS

INTRODUCTION

These appendices contain the background environmental data used in the report, "The Domain of the Ground Effect Machine--The Determination of Physical and Operating Characteristics of Military Overland, Amphibious, and Marine GEMs from World-wide Environmental Criteria." (Volume I)

The tables in these appendices summarize, on a world-wide basis, the features of the natural environment considered most important in the design and operation of Ground Effect Machines (GEMs).

Appendix A contains Climatic and Oceanographic Data; Appendix B contains Natural Environment of Continental Areas; and Appendix C contains Natural Environment of Coastal Areas. Introductory notes in each appendix discuss the sources of data and explain the make-up of the tables. The natural environmental references have been extracted from the Bibliography (Volume I), and repeated in this volume.

Much of the data in Appendices B and C is from classified sources. Therefore, Appendices B and C are classified CONFIDENTIAL.

APPENDIX A

CLIMATIC AND OCEANOGRAPHIC DATA

APPENDIX A

CLIMATIC AND OCEANOGRAPHIC DATA

This appendix contains world-wide climatic data and references to the source materials for world-wide oceanographic data. These data are summarized and discussed in Chapter I of the report (Volume I).

CLIMATIC CLASSIFICATIONS

The first three column headings of Tables A-1 through A-6 list zone numbers and climatic classifications. Zone numbers, starting with 1, have been assigned arbitrarily to all zones on each continent. Letter suffixes have been assigned to the coastal portion of zones with large interior areas but not to primarily coastal zones. The Bailey Climatic Classification refers to the coastal climatic zones. The Critchfield Classification refers to all continental zones, including the incidental coastal regions.

In his work on the climates of coastal regions, Bailey[20] has recognized fourteen types with the character of the vegetation as his basic indicator. He found that while the correspondence between climatic zone and vegetation distribution is not always perfect, the vegetative

cover is the best indicator, yet devised, of the synthesis of all those factors that go to produce climate. Bailey's classifications, criteria, and corresponding vegetative types are contained in Table 1 of the report (VolumeI). The statistical bases for the climatic definitions used by Bailey are the monthly and annual means of temperature and precipitation indicated in Table 1.

Seven-hundred climatic stations were used to establish the zone boundaries according to detailed criteria which are too voluminous to repeat in this appendix. Of these stations, 256 spaced approximately five-hundred miles apart were used for determination of the zone characteristics. Each characteristic was determined by arraying in ascending numerical order, the data for that element from the stations in a given climatic type. From the distributions thus obtained, the 25th and 75th percentile points were determined and are given in the table. Thus, these values describe climatic conditions over approximately 50 per cent of the aggregate length of coast line affected by the given types. These figures are useful for general purposes; however, as Bailey cautions, there are limitations to their application to specific problems.

Critchfield[3, p. 174] states that his system of describing world climates is essentially a geographic one. He defines his principal

climatic types in terms of general characteristics of temperature and precipitation, their seasonal distribution, and the related natural vegetation. Although not as detailed as other systems, this system agrees well with those of Koeppen, Thornthwaite, Trewartha, and Bailey[3, 4, 20] primarily because, as Critchfield points out, a well-ordered system of climates does exist on earth. The characteristics assigned by Critchfield to his various classifications, given in Table 2, (Volume I), are not nearly as detailed as those given by Bailey. The correspondence between the two systems is readily ascertained by a reference to columns 2 and 3 in the tables of this appendix.

SOURCES OF DATA

The ultimate sources of all climatic data are the weather observations made many times daily at thousands of points over the world and transmitted over regional and world-wide communications networks for all to use. Statistically summarized over an extended period, these observations become the data which describe the climatic characteristics of each observation point. By summarizing the climatic data over a region, the climate of the region is described. Most countries publish climatic data for representative points within their boundaries.

The tremendous volume of climatic data and the large number of original sources in which they are contained has made it desirable to

summarize or tabulate them in one set of tables. This task has been accomplished by the Climatological Section, Air Weather Service, U.S. Air Force, the U.S. Weather Bureau, the Naval Weather Service, and the Hydrographic Office. The data presented here are summarized from these tables with supplemental help from a few additional sources. (See Bibliography.)

METHODS OF SUMMARIZING THE DATA

Time did not permit, and the probable small improvement in accuracy attainable did not justify, the use of all the data from each zone for determination of its climatic characteristics. Instead, a sampling procedure was used in which a few equally spaced stations were chosen, and the characteristic zone values of the selected parameters were determined from their data. In the cases of a few very short coastal zones or very small interior zones, only one station was available as the sample. Five to fifteen stations were used in most zones, while twenty or more stations were used for the largest zones. The numbers given in the following tables represent the range of values observed at the sample stations within each zone.

(1) Temperature

The mean daily maximum temperature for the warmest month includes the range of values observed among the sample

stations in the warmest month of the year, regardless of which month it was. Similarly, the numbers under mean daily minimum temperature include the range of values observed for the coldest month. The probable absolute maximum and minimum temperatures are the extremes observed anywhere within the zone during the period of record. Since the periods of record vary from a year or two up to fifty years, these extreme values are indicative only of what might possible be encountered.

(2) Precipitation

The values given for mean monthly precipitation in the wettest and driest months are the ranges (in inches) of the mean precipitation amount measured at the sample stations within the zones. Extreme values are not given; however, they usually approximate one-half and double the mean values. The wettest month is not necessarily the same month at all stations within the zone. Similarly, the driest month may vary among stations. The range of values given for each zone, when considered in relation to zone size, is an indication of the degree of homogeneity of the climate within that zone. The range may also reflect differences in elevation or exposure of the observing points. Data available on the mean number of days with precipitation do not all refer to 0.01 inches; therefore, it was

necessary to adjust the number on the basis of other information. Although the mean number of days usually refers to the same months as does the mean precipitation amounts, they do differ at some stations. The figure given for maximum probable twenty-four hour precipitation usually refers to the maximum observed at any of the sample stations within the zone during the period of record. Accordingly, it is an indication of rainfall intensity over short periods. In a very few cases it was necessary to estimate the probable values on the basis of information from adjacent zones. In other cases, where the reported twenty-four hour maximum obviously referred to rainfall from hurricanes, the figure for the next highest month was used. No value is given where none was reported by any station in the zone and no basis existed for making a reasonable estimate.

(3) Wind Speeds

The four columns in this division present estimated ranges of the probable percentages of time that speeds exceed ten knots and thirty-three knots during the windiest and calmest months. Many complicating factors affect the accuracy of these estimates. Measured wind speed is influenced strongly by terrain features, vegetation cover, exposure of the measuring instrument, and

many other factors. Data on wind speeds are extremely sparse in many parts of the world. Methods of summarizing and presenting the data vary from country to country and, in many cases among the services within the country; hence it has been necessary to adjust their data to the break points we have used, i.e., ten knots and thirty-three knots. All of these factors make it difficult to arrive at reliable estimates for these columns. These data provide rough estimates of ranges of speeds over entire zones and may not include extreme values occurring in small localities.

(4) Relative Humidity

Treatment of the range of mean relative humidities is somewhat different than that of the other parameters. For example, in the data under dampest month, one figure refers to the lowest mean value, usually for midday, reported by any station within the zone, and the other figure refers to the highest value, usually early morning, reported by any station, usually not the same one. In some zones, the month may not even be the same for all stations. The value of the figures in these columns lies in their indication of the dryness or dampness of the climate and of their seasonal variations.

(5) Fog on Coast

This column refers to Bailey's Coastal Climates of the World,[20] in which he designates those coastal regions that are frequently foggy. The "x" designates those coastal zones in which dense fog occurs either 20 per cent of the time during at least one month, 15 per cent of the time during a season of three months, or 10 per cent of the time on an annual basis. He defines dense fog as restricting visibility to less than 1, 100 yards. Few figures were available on the frequency of occurrence of fog restricting visibility to the more significant figure of one hundred yards or less, and it was not possible to classify zones on such a basis. No similar classification of continental zones was available. However, areas experiencing substantial amounts of fog are generally of much smaller extent than the zones used in this study.

(6) Thunderstorms

The range of the mean annual number of days on which thunderstorms were reported at/or in the vicinity of the sample stations is given in this column. The wide range reported for some zones reflects the range of strong local influences and the degree of homogeneity of the zone.

(7) Sand and Dust Storms

Very few data are available on frequency of sand and dust storms. All cases reported occurred in the arid or semi-arid regions from which few data are available. Hence these figures serve only as a rough approximation of the real conditions. It is entirely possible that sand or dust storms occur in regions not indicated in this table. The fact that such storms occurred at all within the zone serves as an indication of the unbonded dusty or sandy nature of the surface.

OCEANOGRAPHIC DATA

The only known comprehensive presentation of climate over the oceans is that contained in the Marine Climatic Atlas of the World[11-15] and related documents,[10, 18] prepared by the U.S. Navy Hydrographic Office and the U.S. Weather Bureau. Because these documents are available to readers of this report, and because of the nature and volume of this material, no attempt is made to reproduce it here. Data on sea conditions are also contained within these documents, as well as in references 26, 28 and 29.

All these data are summarized in Chapter I of the report (Volume I).

TABLE A-1

Climatic Characteristics of Asia - Europe

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds				Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed								
												10 knots		32 knots						
	Bailey	Critchfield	Maximum, Warmest Month	Minimum, Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month	Dampest Month	Driest Month			
1	14	14	40-70	-5- -40	80	-65	0.5-2.0	0-0.4	12-18	3- 9	1.5	40-80	50-80	5-15	2.0- 5	85-95	40-80	x	0- 5	0
2	-	13	61-78	0- -45	100	-80	2.0-4.0	0.1-1.0	12-19	4-11	2.0	25-80	5-40	2- 8	1.0- 5	75-90	45-70	-	3-13	0-5
2A	14	13	55-58	-15- -20	75	-50	1.5-2.0	0.1-0.5	11-14	5- 8	2.0	80-90	45-50	40-45	5.0-10	85-90	75-85	x	9-12	0
2B	13	13	55-65	-20- +10	82	-56	1.7-4.0	0.3-1.5	11-17	4- 7	2.0	70-90	35-40	5-12	0.5- 5	80-90	60-80	x	5-10	0
2C	13	13	58-68	-15- -20	88	-51	10.0-20.0	0.1-0.5	10-12	2- 6	3.6	40-80	30-60	1- 3	Tr - 1	80-92	55-83	x	10-15	0
2D	13	13	66-70	2- 14	98	-40	2.0-3.5	1.0-1.5	15-18	9-12	2.1	20-30	15-25	0.3-2	0- 1	88-91	55-77	x	5-12	0
2E	14	13	51-66	0- 17	90	-45	2.0-3.0	1.0-2.0	15-18	8-10	1.5	60-90	30-60	5-15	1.0- 5	85-90	70-82	-	1- 4	0
2F	13	13	62-65	0- 5	94	-49	2.0-3.0	0.5-1.0	15-18	8-10	2.5	40-60	25-50	3- 6	1.0- 2	87-92	62-80	-	9-12	0
3	13	13/12	65-72	-17- +10	92	-40	2.0-5.0	0.1-1.0	10-24	7-14	5.4	35-90	20-60	2- 5	Tr - 2	85-95	65-85	x	10-15	0
4	13	14	55-62	-15- -35	82	-59	1.0-2.0	0.1-0.5	10-16	2- 7	2.0	5-70	2-35	Tr- 3	0- 1	80-90	55-80	x	0- 2	0
5	-	12	75-85	-12- -30	105	-58	3.0-6.0	0.1-0.2	14-18	3- 6	5.8	30-40	15-35	2- 8	0- 3	60-90	40-75	-	7-24	2-25
5A	13	12	72-74	0- - 2	96	-22	5.0-6.0	0.5-1.0	14-16	3- 4	5.2	60-90	40-70	4-10	1- 3	75-92	50-70	x	10-15	0- 5
6	-	11	78-88	-20- +20	103	-43	5.0-9.0	0.1-1.0	12-18	1- 6	5.6	20-40	10-20	0- 2	0-Tr	60-95	40-70	-	11-30	0-25*
6A	10	11	80-86	10- 30	103	-20	6.0-12.0	0.3-1.5	10-18	3- 8	10.0	20-40	15-30	Tr- 5	0- 0.5	75-95	40-80	x †	6-15	0-25
7	-	10	70-95	-25- +15	111	-48	1.0-3.0	Tr -0.3	8-12	< 1- 7	3.0	30-80	5-40	1-10	0- 1	75-95	40-70	-	5-30	5-10
7A	10	10	83-88	13- 16	104	- 8	7.0-8.0	0-0.2	11-13	1- 3	7.2	25-40	5-15	3-10	0-Tr	75-95	55-70	-	6-10	0- 5
7B	-	10	75-80	20- 25	95	-14	1.0-2.0	0.5-1.0	12-14	4- 6	3.0	35-65	15-25	8-12	0- 3	80-95	40-80	-	17-19	0
7C	-	6	78-80	25- 30	100	- 4	1.0-2.0	0.5-1.0	12-15	6- 8	2.0	40-60	20-25	8-12	Tr- 3	85-95	45-80	-	7-10	0
8	-	11	90-95	19- 22	113	- 1	4.0-8.0	Tr -1.0	7-13	1- 3	5.0	20-50	5-20	Tr- 5	0-Tr	70-85	40-70	-	6-20	0
8A	10	11	82-85	22- 25	104	4	6.0-8.0	0.2-0.5	9-14	2- 3	10.0	50-80	20-40	5-10	Tr- 3	80-95	50-70	x †	20-22	0
9	10	7/11/12	74-87	10- 35	102	-21	8.0-10.0	2.0-4.0	19-28	11-14	7.0	20-85	5-50	2-10	0- 3	75-95	60-80	x †	15-20	0
10	10	11/12	70-85	8- 30	101	-19	6.0-10.0	1.0-2.0	15-18	7-11	10.0	20-60	10-25	Tr-10	0- 3	80-95	60-80	x †	5-10	0
11	6	7	85-90	30- 35	104	13	8.0-14.0	2.0-3.0	14-18	8-10	10.0	20-50	10-30	Tr- 2	0-Tr	70-90	50-75	-	10-15	0
12	-	7	80-95	30- 50	112	4	6.0-10.0	0.1-1.5	7-21	2- 7	8.5	5-50	0-40	Tr- 5	0- 1	70-90	50-80	-	10-55	0

† Part of Zone

* 98 Days Reported at Kalgan

TABLE A-1 (Cont.)

Climatic Characteristics of Asia - Europe

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds						Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (inches)		Mean No. Days With 0.01 inches or more		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed										
												10 knots		32 knots								
	Bailey	Critchfield	Maximum, Warmest Month	Minimum, Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month			Dampest Month	Driest Month			
12A	6	7	87-92	32-60	107	25	7-16	1.0-2.0	13-22	4- 8	12.0	10-60	5-50	Tr-2	0-Tr			80-95	60-80	x †	1- 20	0
13	2	2	86-90	54-58	100	45	9-11	0.5-1.0	8-12	4- 6	8.0	40-50	20-30	2-4	Tr-1			80-95	70-85	–	1- 10	0
14	1	1/2	87-93	69-73	101	58	6-23	0.2-5.0	13-23	1-15	10.0	15-75	5-25	Tr-1	0-Tr			70-95	53-96	–	30-130	0
15	–	16	8 -95	70-75	101	67	15-30	3.0-14.0	20-26	9-15	15.0	10-30	5-10	0-Tr	0-Tr			80-95	75-90	–	100-160	0
16	1	3	88-90	70-73	98	63	10-13	0.5-2.0	15-19	3- 9	12.0	50-65	15-25	0-Tr	0			80-95	75-90	–	30- 40	0
17	1	1	88-92	72-76	100	62	11-17	3.0-10.0	15-22	7-17	12.0	20-60	5-20	0-Tr	0			70-97	60-95	–	25-125	0
18	–	16	90-95	70-75	100	68	15-25	5.0-15.0	20-26	9-15	15.0	15-30	2- 5	0-Tr	0			80-95	75-90	–	40-160	0
19	1	1	87-90	69-73	97	58	13-28	3.0-10.0	20-25	8-15	12.0	15-55	5-10	0-Tr	0			65-95	52-94	–	38-130	0
20	1	2	92-94	59-69	108	39	15-26	1.0-2.0	14-20	4- 7	10.0	45-60	15-25	0-Tr	0			80-95	70-85	–	10- 60	0
21	–	3	90-102	50-67	114	31	6-15	Tr-0.5	9-20	<1- 1	8.0	5-25	1-10	0-Tr	0			60-95	40-80	–	20- 80	0
21A	2	3	86-88	70-71	97	55	6- 7	0.1-0.2	12-13	1- 2	6.0	70-80	20-25	0-Tr	0			75-95	60-85	–	10- 15	0
21B	3	3	89-91	66-68	100	54	8- 9	0 -0.1	16-18	0- 1	7.0	70-80	20-25	0-Tr	0			75-95	60-80	–	10- 15	0
21C	2	3	89-95	70-72	104	57	8-13	0 -0.1	21-23	0- 1	7.0	60-75	15-20	0-Tr	0			75-95	65-90	–	10- 50	0
21D	1	3	88-93	70-72	99	60	10-13	0.1-0.5	16-19	0- 1	9.0	30-70	15-20	0-Tr	0			75-95	65-90	–	30- 60	0
21E	2	3	94-97	67-70	106	52	11-17	0.4-2.0	13-16	1- 2	12.0	40-45	10-15	0-Tr	0			94-97	50-90	–	50- 65	0
22	1	1	89-95	60-75	102	49	10-19	1.0-6.0	9-26	1-14	14.8	10-40	5-10	0-Tr	0			70-98	60-97	–	50-180	0
23	1	1	88-90	71-74	96	60	10-20	2.0-10.0	16-21	4-12	12.0	10-65	5-30	0-Tr	0			62-96	53-95	–	40-185	0
23A	2	3	90-92	70-71	101	58	8-15	Tr-0.5	15-18	1	12.0	25-40	5-20	0-Tr	0			60-94	40-85	–	50- 80	0
24	–	2	95-100	50-55	108	44	11-21	Tr-0.2	25-23	0- 1	8.3	5-10	Tr- 5	0-Tr	0			70-97	33-87	–	50-140	0
24A	1	2	89-98	55-68	107	43	22-55	0.1-0.8	19-28	0- 1	15.0	40-65	5-15	0-Tr	0			82-98	47-85	–	50- 60	0
25	–	3	101-107	48-52	120	31	6-11	0.1-0.2	9-13	<1	10.0	10-25	5-15	0-Tr	0			65-87	14-32	–	15- 32	0
25A	2	3	92-99	56-68	116	44	9-15	0.2-0.7	9-18	<1	10.0	55-80	15-25	0-1	0			75-90	61-80	–	30- 60	0
25B	2	3	91-100	57-68	111	40	17-24	Tr	16-22	<1	12.0	85-90	10-15	0-1	0			79-86	30-70	–	15- 18	0
25C	1	3	91-92	66-72	108	44	17-38	Tr-0.8	22-27	0- 1	14.2	40-85	5-20	0-Tr	0			85-94	30-70	–	30-100	0
25D	2	3	87-90	71-73	100	61	13-14	0.5-0.7	16-18	1- 2	8.5	40-60	10-15	0-1	0			80-90	60-75	–	85- 95	0
26	–	5	93-103	57-69	112	46	6- 8	0.1-0.2	9-11	>1	6.4	10-25	5-15	0-Tr	0			63-87	24-62	–	30- 50	0
26A	3	5	95-100	65-69	105	62	7- 8	0.3-0.5	10-11	>1	6.0	50-70	12-15	0-1	0			65-90	35-70	–	60- 80	0
27	2	2/3	89-93	67-74	104	50	7-15	0.5-2.5	16-23	1- 6	10.0	55-70	2-25	0-1	0			75-94	60-92	–	55- 80	0

† Part of Zone

TABLE A-1 (Cont.)

Climatic Characteristics of Asia - Europe

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds				Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed								
												10 knots		32 knots						
	Bailey	Critchfield	Maximum, Warmest Month	Minimum, Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month	Dampest Month	Driest Month			
28	—	7	67- 91	35- 50	116	20	13.0-31.0	0.2-0.7	12-26	1	15.0	15-30	5-15	0- 2	0	80-95	50-75	—	25-45	0
29	—	16	66- 86	-2- +35	102	-38	0.5- 5.0	Tr-0.5	2-20	<1- 5	10.0	10-30	3-15	0- 3	0-Tr	40-85	25-50	—	5-70	0- 50
30	—	9	90-105	-3- +12	115	-16	0.5- 1.3	0-0.1	2- 7	0- 1	1.0	15-50	5-30	3-10	0-3	50-90	18-50	—	0-15	up to 183
31	—	5	107-108	43- 50	121	29	2.0- 5.0	0-0.1	2- 6	<1	7.0	2-15	0-10	0-Tr	0	47-78	12-30	—	25-35	0
31A	3	5	89- 95	60- 65	105	40	6.0- 8.0	0-Tr	6-10	<1	10.0	90-95	15-20	0- 1	0	61-90	30-60	—	10-15	0
32	—	4	100-114	31- 44	127	12	0.7- 2.0	0-0.1	2- 5	0- <1	3.0	10-90	5-40	1-10	0-Tr	33-84	13-44	—	8-14	up to 35
32A	4	4	93-113	44- 58	123	24	1.0- 3.0	0-Tr	2- 7	0- <1	7.0	15-90	5-25	0- 5	0-Tr	40-80	30-70	—	4-14	up to 32
32B	5	4	98-110	50- 56	119	35	0.5- 1.0	0	2- 5	0	2.8	50-55	5-20	0- 5	0-Tr	77-89	60-70	—	0- 6	20-135
32C	4	4	98-102	52- 66	116	37	1.0- 1.5	0	2	0	4.3	15-60	10-25	0- 2	0-Tr	55-85	50-60	—	4-10	7- 30
32D	5	4	92- 95	66- 73	115	55	0.2- 1.7	0	3- 4	0	3.0	15-90	10-60	1-10	0-Tr	60-91	45-70	—	2- 4	up to 115
33	—	5	80-110	18- 40	122	-22	1.0- 4.0	0-0.2	1-12	0- 2	3.0	10-70	5-40	1- 5	0-1	50-95	12-65	—	1-30	up to 30
33A	7	5	88- 94	39- 51	112	17	3.0-10.0	0-0.2	9-15	0- 1	11.0	40-60	15-30	1-12	0-Tr	50-80	35-70	—	8-50	up to 5
34	—	4	101-103	30- 35	116	0	0.5- 1.5	0	2- 5	0	2.3	10-80	5-30	3-50	0-3	35-80	12-37	—	2- 4	up to 22
35	—	9	86- 93	7- 32	110	-24	0.5- 1.0	Tr-0.4	5- 8	<1- 3	2.0	25-65	15-45	1-12	Tr-3	65-90	25-65	—	5-10	0- 5
36	—	16	62- 88	12- 25	104	-16	2.0- 6.0	0.2-1.5	9-18	2- 7	4.3	10-40	5-25	2- 5	0-Tr	63-91	35-65	—	5-40	0
37	—	7	78- 80	38- 40	100	19	4.0- 5.0	1.0-2.0	12-14	7- 8	3.7	35-45	15-20	5-10	0-Tr	80-85	65-70	—	10-15	0
38	—	6	77- 81	36- 37	105	18	3.0- 7.0	1.0-2.0	15-17	5- 6	8.6	40-45	15-20	5-10	0-Tr	75-80	60-75	—	7-15	0
39	—	7	83- 85	27- 30	106	- 3	2.5- 3.5	1.0-1.5	10-11	4- 9	4.0	40-60	15-20	5-10	0-Tr	75-90	55-80	—	18-22	0
40	9	6	86- 88	35- 36	109	-14	3.5- 4.5	0.3-1.0	13-16	1- 3	8.0	30-55	5-20	4-10	0-Tr	60-85	40-70	—	15-20	0
41	—	6	85- 95	34- 48	114	- 2	4.0- 7.0	Tr-1	9-18	<1- 4	7.6	15-80	5-50	1-12	0-Tr	60-85	40-70	—	8-15	0
41A	7	6	78- 91	30- 47	109	15	2.0- 9.0	Tr-2	9-17	1- 6	8.0	40-55	15-25	4-12	0-Tr	60-85	35-75	—	3-44	0
42	—	11	72- 87	17- 34	107	-24	2.0- 5.0	1.0-2.0	9-16	4-11	5.4	15-45	10-25	2- 8	0-Tr	65-92	40-80	—	15-40	0
42A	—	11	80- 82	23- 25	100	- 7	1.5- 2.5	0.5-1.0	11-13	2- 4	3.0	40-65	15-25	5-10	0-Tr	75-90	50-80	—	17-20	0
42B	10	11	82- 84	32- 36	100	9	3.0- 6.0	1.0-3.0	10-11	6- 7	5.4	40-50	15-25	8-12	0-Tr	75-90	60-70	—	17-23	0
43	—	6	78- 86	32- 40	107	13	3.0- 5.0	0.5-2.0	12-14	1- 5	2.5	20-40	5-20	Tr- 2	0-Tr	70-85	40-70	—	8-14	0
43A	7	6	83- 89	38- 47	107	17	3.0- 6.0	0.1-1.5	8-16	1- 5	7.0	25-55	2-25	3-10	0-Tr	60-80	40-65	—	5-25	0
44	—	16	68- 83	0- 30	102	-30	3.0- 7.0	1.0-4.0	12-17	5-13	4.9	10-30	2-15	Tr- 5	0-Tr	50-80	30-70	—	18-52	0
45	7	6	80- 87	36- 47	108	9	3.0- 7.0	0.1-2.0	6-13	<5-6	8.7	10-60	5-25	1-30	0-5	60-80	45-75	—	9-22	0

TABLE A-1 (Cont.)

Climatic Characteristics of Asia - Europe

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds				Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunderstorms	Mean Annual No. Days With Dust- or Sandstorms
			Daily Mean		Probable Absolute		Mean Monthly (inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed								
												10 knots		32 knots						
	Bailey	Critchfield	Maximum, Warmest Month	Minimum, Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month	Dampest Month	Driest Month			
45	—	10	86-96	21- 42	117	10	1.5- 5	0.0-0.5	9-11	1- 2	4.0	20-60	10-30	3-10	0-1	60-88	40-75	—	11-20	0
47	—	6	85-88	35- 42	107	19	3.0- 5	0.1-0.2	11-12	1- 2	4.0	20-30	10-15	Tr- 1	0-Tr	70-93	30-55	—	12-14	0
47A	7	6	76-85	41- 47	107	26	3.0- 7	Tr-1	12-18	1- 3	4.4	35-50	15-40	1- 5	0-Tr	70-88	48-78	—	7-22	0
48	—	8	71-88	29- 35	105	-14	2.0- 4	1.0-2.0	11-17	8-13	5.5	25-55	10-55	1- 5	0-1	78-93	50-83	—	11-36	0
46A	9	8	72-80	38- 42	104	20	4.0- 8	1.0-2.0	17-18	8- 9	3.7	25-65	20-40	8-11	0-Tr	75-95	60-77	x	10-12	0
48B	10	8	67-82	24- 43	111	-10	3.0- 5	1.0-2.0	12-24	8-12	3.0	20-75	10-50	1-12	0-3	80-95	55-90	x partial	2-23	0
49	10	8	63-71	34- 40	94	5	2.0- 7	1.0-3.0	16-26	12-17	2.5	35-80	20-55	1-15	0-Tr	80-90	60-85	—	5-15	0
50	—	12	70-95	-14-+28	104	-56	2.0- 6	0.3-1.5	11-17	6-14	3.0	25-50	20-35	1- 3	0-1	75-87	40-73	—	10-40	0-5
50A	10	12	68-73	12- 25	97	-39	3.0-3.5	1.0-1.5	15-17	12-14	4.3	25-65	10-45	1-10	0-1	80-95	50-75	x partial	14-21	0
51	—	12	68-72	10- 15	97	-29	2.0- 3	1.0-1.5	15-16	9-11	4.0	20-40	5-20	Tr- 2	0-Tr	85-90	50-60	—	8-10	0
51A	10	12	69-71	20- 26	95	-26	2.0- 4	1.0-2.0	14-17	9-11	4.0	30-70	20-45	1-12	0-1	85-90	50-65	x partial	8-10	0
52	10	8	62-66	27- 31	89	- 6	6.0-10	2.0-4.0	11-19	6-12	5.0	30-70	20-40	3-15	0-1	80-90	60-80	x	4- 5	0
53	13	13	60-70	20- 25	95	-15	3.0- 7	1.0-3.0	17-23	9-13	5.0	30-70	25-35	4-15	Tr-3	74-90	55-70	x	1- 5	0
54	—	14	40-60	- 5-+ 3	85	-59	2.0- 3	0.5-1.0	12-16	4- 8	2.0	20-50	10-25	2- 6	Tr-1	85-90	55-75	—	0- 3	0
54A	14	14	57-58	20- 24	85	- 4	4.0- 5	1.0-2.0	16-17	10-11	2.0	30-70	15-35	6-10	Tr-2	74-85	65-75	—	0- 1	0
55	14	8	57-59	26- 30	83	2	3.0-10	2.0-5.0	21-22	14-15	5.9	65-75	35-45	10-25	0-3	75-85	65-75	x	2- 5	0
56	—	14	56-58	16- 22	83	-36	2.0- 3	0.4-1.0	14-17	5-11	1.4	50-70	20-35	5-15	0-2	75-85	65-75	—	0- 3	0
56A	14	14	53-58	22- 28	83	-21	2.0- 4	0.6-1.1	15-19	7-11	4.4	65-75	25-40	10-25	0-5	75-85	65-75	x	0- 1	0

TABLE A-2

Climatic Characteristics of Africa

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds						Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed										
												10 knots		32 knots								
	Bailey	Critchfield	Maximum, Warmest Month	Minimum, Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month			Dampest Month	Driest Month			
1	–	6	91- 97	37-39	117	19	2.0- 4.0	Tr-0.2	8-12	1- 2	0	25-50	5-20	Tr-1	0-Tr			60-85	25-55	–	10- 22	0
1A	7	6	81- 91	44-49	118	30	2.0- 6.0	Tr-0.2	8-15	41- 2	0	30-60	20-30	2-5	0-Tr			65-90	40-85	–	10- 25	0
2	–	5	95-106	32-43	122	15	0.5- 2.0	Tr-0.2	3- 7	1- 3	0	30-50	5-30	1-5	0-Tr			40-90	20-70	–	3- 13	6-30
2A	12	5	75- 80	50-52	119	35	1.0- 2.0	Tr-0.1	3- 4	<1	0	40-70	20-35	1-3	0-Tr			80-95	50-60	–	1- 4	0
2B	7	5	86- 91	43-47	122	25	1.0- 5.0	0-Tr	4-11	0- 1	0	45-60	25-35	3-7	0-Tr			55-90	50-75	–	14- 17	0
3	7	5	85- 91	42-52	114	36	2.0- 5.0	0-Tr	13-18	0-Tr	0	50-60	20-30	3-6	0-Tr			65-90	40-75	–	5- 15	0
4	–	4	95-117	34-56	133	20	0.0- 1.5	0	0- 5	0	2.4	25-50	5-30	1-3	0-Tr			20-70	10-50	–	0- 1	3-55
4A	5	4	85- 91	50-54	113	45	0.5- 1.0	0	3- 7	0	3.3	65-75	15-40	0-1	0-Tr			55-90	25-85	–	5- 10	0
4B	4	4	91- 93	57-61	117	41	5.0- 6.0	0	6-12	0	0.8	40-65	25-45	0-1	0-Tr			60-90	20-85	–	10- 25	0
4C	12	4	85- 87	46-48	109	38	1.0- 2.0	0	6- 7	0	0	50-70	20-30	2-6	0-Tr			60-90	45-75	–	0- 1	6- 8
4D	12	4	82- 89	47-51	115	32	0.5- 2.0	0	4- 9	0	3.0	30-50	15-30	1-3	0-Tr			60-90	45-80	–	0- 5	6- 8
4E	5	4	93-102	48-63	118	39	0.1- 0.5	0	Tr- 2	0	1.5	30-80	25-50	Tr-1	0-Tr			50-75	45-65	–	0- 1	0- 5
4F	4	4	104-110	66-72	118	50	1.0- 3.0	0-Tr	4- 7	0-Tr	5.2	35-70	5-30	1-5	0-Tr			60-80	30-60	–	0- 1	0-50
5	–	5	88-114	50-72	120	33	4.0-10.0	0-Tr	7-20	0-Tr	8.4	10-40	5-20	0-2	0-Tr			40-95	8-50	–	15- 90	20-35
5A	3	5	88- 90	60-64	100	59	10.0-20.0	0	17-21	0	8.4	40-50	15-20	0-1	0-Tr			65-91	34-85	–	6- 25	0
5B	4	5	91-105	67-72	117	52	0.5- 1.5	0-Tr	1- 9	0-Tr	6.4	30-95	15-40	2-15	0-1			65-94	35-85	–	2- 10	20-60
6	–	16	79- 95	40-55	93	27	6.0-17.0	0-0.5	16-30	0- 2	3.9	10-40	5-25	0-5	0-1			70-95	10-70	–	90-135	0
7	–	3	88-105	54-65	115	43	7.0-15.0	0-0.6	11-27	0- 2	6.7	10-30	5-15	0-1	0-Tr			62-100	8-86	–	30-195	0
7A	2	3	86- 88	63-64	106	52	18.0-25.0	0	17-26	0	7.9	30-55	5-15	0-1	0-Tr			74-98	33-90	–	25- 80	0
7B	1	3	89- 91	72-74	97	64	28.0-51.0	0-0.3	27-30	0- 1	14.2	40-45	5-10	0-1	0-Tr			79-98	52-91	–	80-115	0
7C	1	2	89- 91	71-72	97	63	36.0-37.0	0.1-0.3	26-28	1	12.3	35-45	5-10	0-1	0-Tr			82-95	70-86	–	50-100	0
7D	1	3	88- 90	71-72	95	61	14.0-20.0	1.0-2.0	16-19	2- 3	10.8	20-35	5-10	0-1	0-Tr			75-98	65-90	x	50-110	0
7E	2	3	88- 89	71-72	100	54	8.0-12.0	0.5-1.0	11-16	1- 2	5.5	25-30	5-10	0-1	0-Tr			75-88	60-85	x	40- 80	0
7F	3	3	88- 89	71-72	100	59	7.0- 8.0	0.4-0.6	10-12	1	11.9	20-25	5-10	0-2	0-Tr			75-95	60-92	–	10- 40	0
7G	2	3	88- 92	71-73	109	50	10.0-15.0	0.5-1.0	13-17	1- 2	9.0	25-30	5-10	0-2	0-Tr			78-95	69-92	?	48- 70	0
7H	1	3	90- 92	71-73	109	50	12.0-20.0	0.5-1.0	17-20	2	8.9	30-40	5-10	0-2	0-Tr			80-95	64-91	–	40- 70	0
8	–	1	89-100	62-87	109	43	6.0-18.0	0.1-3.0	14-27	1- 8	8.8	10-15	5-10	0-1	0-Tr			70-98	60-96	–	80-150	0
8A	1	1	87- 89	69-71	105	49	16.0-17.0	0.2-2.0	22-24	1- 3	8.4	20-45	5-10	0-2	0-Tr			80-95	70-93	–	135-200	0

TABLE A-2 (Cont.)

Climatic Characteristics of Africa

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds				Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed								
												10 knots		32 knots						
	Bailey	Critchfield	Maximum, Warmest Month	Minimum, Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month	Dampest Month	Driest Month			
9	-	16	75- 86	47-60	94	37	5.0- 9.0	Tr-1.0	13-19	1- 4	4.5	15-25	5-10	Tr-1	0-Tr	65-98	40-93	-	100-125	0
10	-	16	81- 85	48-53	93	36	5.0- 9.0	Tr-2.0	10-21	3- 5	3.9	15-25	10-15	0-Tr	0-Tr	55-90	35-75	-	5- 70	0
11	-	3	83-106	36-65	115	23	4.0-14.0	0-0.4	10-25	0- 2	8.0	10-40	5-20	0-Tr	0	50-95	25-85	-	5-125	
11A	3	3	92- 97	70-75	100	62	3.0- 4.0	0-Tr	10-13	0-Tr	2.0	60-80	15-20	1-3	0-Tr	75-95	70-90	-	2- 10	
11B	2	3	87- 91	60-70	109	45	3.0-14.0	0.1-1.0	14-19	1- 5	13.6	25-75	15-40	0-2	0-Tr	70-95	55-90	-	25- 70	0
11C	2	3	87- 90	64-67	99	55	7.0-18.0	0-0.1	11-21	0-<1	8.9	20-30	5-10	0-1	0-Tr	73-95	35-90	-	100-130	0
12	-	5	83- 95	30-45	111	15	2.0- 7.0	0-0.2	2-18	0- 1	8.1	10-15	5-10	0-1	0-Tr	34-85	11-68	-	40- 60	0
12A	3	5	86- 91	64-65	99	57	5.0- 8.0	0-Tr	8-10	0-<1	9.8	15-20	5-10	0-1	0-Tr	78-88	73-85	-	30- 50	0
12B	12	5	93- 94	40-60	112	28	1.0- 2.0	0.1-0.2	6- 7	0- 1	2.0	55-60	35-40	2-3	Tr-1	55-90	50-85	x	1- 5	0
12C	6	5	68- 78	45-49	107	36	2.0- 4.0	1.0-3.0	8- 9	5- 6	6.4	50-75	45-50	8-10	Tr-4	67-92	57-84	-	5- 15	0
13	-	4	91-103	37-39	115	27	1.0- 2.0	0-0.1	3- 4	0- 1	1.4	10-25	5-20	0-2	0-Tr	28-58	13-45	-	20- 24	up to 10
13A	4	4	84- 87	56-62	102	44	1.0- 3.0	0	3- 9	0	5.4	15-50	5-20	0-1	0-Tr	76-90	70-82	x	9- 13	0
13B	5	4	68- 79	44-52	115	31	0.2- 0.4	0-0.1	1- 3	0- 1	1.7	40-60	25-35	1-3	0-1	50-90	30-80	x	3- 5	0
14	-	7	86- 90	32-33	109	17	3.0- 6.0	0.3-0.6	12-13	1- 3	12.0	40-60	30-40	2-5	Tr-1	46-92	30-75	-	50- 60	0
14A	6	7	76- 82	49-56	106	36	3.0- 6.0	1.0-2.0	12-14	3- 4	12.7	50-60	40-50	3-8	Tr-3	73-90	54-75	-	20- 30	0
15	7	6	80- 86	40-59	107	25	2.0- 4.0	0.4-2.0	6-12	1- 4	3.9	55-60	35-40	5-8	1-2	65-91	55-84	x partial	5- 10	0
16	-	1	85- 90	50-56	100	45	11.0-15.0	0.1-0.2	15	1	8.5	20-60	5-30	Tr-5	0-Tr	68-92	44-78	-	25- 30	0
16A	1	1	88- 93	60-70	103	34	5.0-18.0	0.1-4.0	14-21	<1-11	15.1	35-80	10-50	1-20	0-1	73-96	40-90	-	35- 90	0
17	-	3	81- 91	48-49	104	34	9.0-13.0	0.1-0.2	10-16	<1- 1	5.9	25-35	20-30	0-1	0-Tr	54-93	31-85	-	75-100	0
17A	2	3	90- 94	31-68	101	48	9.0-15.0	Tr-0.1	14-16	0- 1	11.2	30-40	10-15	0-1	0-Tr	70-93	40-85	-	75- 80	0
17B	2	3	86- 88	60-62	97	50	9.0-11.0	2.0-3.0	10-12	5- 6	8.4	40-70	30-55	1-5	0-Tr	81-91	73-86	-	50- 55	0
18	-	3	96- 98	50-53	108	39	4.0- 8.0	0.1-0.3	8-11	<1- 2	6.6	35-60	15-50	1-4	0-Tr	60-92	40-83	-	45- 50	0
18A	3	3	90- 92	58-60	108	43	5.0- 7.0	Tr-0.2	6- 7	0- 1	6.1	40-65	20-55	2-4	0-Tr	76-87	66-80	-	65- 70	0

TABLE A-3

Climatic Characteristics of South America

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds						Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (Inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed										
												10 knots		32 knots								
	Bailey	Critchfield	Maximum Warmest Month	Minimum Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month	Dampest Month	Driest Month				
1	3	5	92- 99	64-74	107	50	4.0- 9.0	Trace	7-12	0- 1	6	50-85	20-50	0	0	45-98	50-90	–	30-70	0
2	–	3	92- 96	70-73	104	63	11.0-15.0	Tr- 1.5	15-24	0- 3	6	10-20	5-10	0	0	55-98	50-90	–	45-70	0
2A	2	3	90- 97	65-70	104	55	8.0- 9.0	0.5- 1.0	16-18	1- 4	4	45-65	20-35	0	0	55-98	50-90	–	10-25	0
3A	2	2	90- 97	65-70	101	56	6.0-10.0	0.5- 2.0	16-21	4- 9	6	50-60	15-30	0	0	55-98	50-90	–	20-30	0
3B	1	2	87- 91	70-74	99	63	12.0-22.0	1.0- 4.0	22-27	6-11	7	50-70	15-20	0	0	75-98	66-92	–	10-60	0
4	–	1	85- 95	65-72	101	41-57	12.0-18.0	0.5- 6.0	15-26	2-16	8	10-20	2- 5	0	0	65-98	47-90	–	20-90	0
4A	1	1	87- 92	70-74	95	65	18.0-20.0	1.0- 4.0	25-28	2-13	5	40-75	20-40	0	0	70-98	65-90	–	30-70	0
5	–	3	84- 97	49-68	103	30-60	9.0-15.0	0.2- 1.0	12-20	0- 3	7	20-50	5-10	0	0	60-98	45-90	–	8-55	0
5A	2	3	90- 93	73-75	100	69	11.0-12.0	0.1-	22-26	1	5	70-90	20-40	0	0	60-98	50-90	–	25-30	0
5B	2	3	90- 93	73-75	100	69	11.0-12.0	0.1-	22-26	1	5	70-75	30-35	0	0	60-98	50-90	–	6- 8	0
5C	1	3	87- 90	68-70	95	61	9.0-14.0	0.7-	18-26	5- 8	7	60-75	25-35	0-Tr	0	60-98	55-90	–	3- 6	0
5D	2	3	86- 88	69-71	100	55	11.0-12.0	1.0- 2.0	22-24	6- 8	7	50-60	15-25	0-Tr	0	60-98	55-90	–	3-10	0
5E	2	3	84- 88	54-64	102	45	5.0- 8.0	1.0- 2.0	13-16	6- 8	9	35-45	20-30	0- 1	0	65-98	55-95	–	6-36	0
6	3	5	88- 96	59-70	102	60	9.0-14.0	0.5-	16-19	1- 3	10	70-75	25-30	0	0	60-98	45-75	–	7-85	0
7	1	1	86- 88	62-69	95	60	8.0-12.0	2.0- 3.0	19-20	5-12	5	35-45	15-25	0-Tr	0	67-98	65-98	–	15-30	0
8	1	1	79- 85	59-62	95	32-45	10.0-17.0	2.5- 7.0	17-20	2- 8	5	35-40	15-20	1- 4	0-Tr	66-98	56-96	–	5-10	0
9	–	7	78- 92	32-50	111	18-31	2.0- 8.0	1.3- 3.0	7-11	2- 6	10	20-50	10-20	1- 3	0-Tr	60-93	40-85	–	20-60	0
9A	6	7	83- 87	49-57	105	25-35	5.0- 8.0	2.0- 4.0	12-14	7- 9	8	35-60	20-50	3- 8	1- 2	60-98	48-95	–	25-45	0
10	–	10	92- 98	34-48	113	12-20	4.0- 5.0	1.0- 2.0	7- 8	2- 4	5	20-50	10-20	1- 5	0-Tr	62-98	35-90	–	18-20	0
10A	11	10	86- 88	37-39	108	18-23	1.5- 3.0	0.5- 1.0	5- 7	2- 3	4	55-65	30-85	7- 8	1- 3	55-95	30-85	–	10-20	0
11	–	9	75-103	30-46	120	0-23	1.0- 7.0	0.2- 0.5	6- 9	0- 2	6	20- 30	10-25	4- 8	8- 1	55-95	30-80	–	20-55	0
11A	12	9	72- 86	30-36	108	1-15	0.4- 1.5	0.2- 0.7	6- 8	0- 2	2	55-70	30-40	8-17	1- 4	50-85	30-70	–	5-15	0
12	–	10	68- 90	26-30	106	5-10	0.5- 1.0	0.0- 0.2	3- 6	0- 2	2	30-65	15-30	4-12	0- 2	44-95	25-65	–	5-30	0
12A	11	10	60- 70	28-33	80- 93	5-20	0.8- 1.2	0.2- 0.4	5- 8	2- 4	2	65-70	35-40	15-20	4- 5	45-98	30-85	–	1- 4	0
13	14	8	52- 64	25-32	81	7-16	1.5- 4.0	0.5- 2.0	11-19	1-15	3	70-85	20-50	18-32	6- 8	80-95	55-85	x partial	0- 1	0
14	8	8	57- 74	36-39	95	19-27	12.0-20.0	2.5-12.0	19-26	7-21	6	55-80	20-55	7-22	1- 8	80-95	50-88	x	0- 7	0
15	9	8	68- 70	41-45	96	24-36	6.0-11.0	0.5- 1.5	17-22	2- 7	5	50-55	35-40	4- 7	1- 2	78-95	60-85	x	2- 5	0-5
16	–	6	76- 85	37-42	99	24-28	3.0-10.0	0.0- 0.3	7-14	0- 1	7	50-55	30-35	2- 3	0	69-95	35-85	x	1- 3	0-5

TABLE A-3 (Cont.)

Climatic Characteristics of South America

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds						Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (Inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed										
												10 knots		32 knots								
	Bailey	Critchfield	Maximum Warmest Month	Minimum Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month			Dampest Month	Driest Month			
17	12	4	72-80	43-47	81	36-37	1.5- 4.0	0.0- 0.1	3- 7	0- 1	4	40-55	20-35	0- 1	0			75-90	65-88	x	0- 2	0- 5
18	5	4	75-84	47-56	96	34-50	0.0- 0.4	0	3-17	0	1	15-50	5-25	0-Tr	0			67-95	55-87	x partial	0- 5	0-30
19	4	4	85-90	57-61	98	47-51	0.2- 0.6	0	4- 5	0	1	25-30	5-10	0-Tr	0			60-95	30-80		2- 4	
20	3	4	87-95	58-62	103	52	2.0- 3.0	0	6- 2	0	3	40-45	5-10	0	0			55-90	20-70		0- 1	
21	2	3	87-89	66-68	98	56	6.0-12.0	0.0- 0.5	18-21	1- 6	4	35-45	5-10	0	0			65-98	50-90		1-14	
22	1	3	84-91	61-75	90-107	52-67	8.0-43.0	1.0-21.0	18-29	4-17	5	25-45	5-25	0	0			75-98	65-90		10-60	
23	-	5	65-85	0-65	70-105	25-60	4.0- 7.0	0.2- 2.0	3-22	0- 7	3	20-40	10-20	4-30	0-5			50-98	20-90		1-60	
24	2	3	88-92	70-72	103	63-68	8.0-18.0	Tr- 0.5	8-16	1- 6	4	80-85	20-35	1	0			70-98	50-90		20-60	

TABLE A-4

Climatic Characteristics of North America

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds				Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (Inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed								
												10 knots		32 knots						
	Bailey	Critchfield	Maximum, Warmest Month	Minimum, Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month	Dampest Month	Driest Month			
1	–	14	58- 63	-31- -40	86	-63	0.5- 3	Tr-0.1	8-28	2- 8	1.0	15-45	15-30	1- 5	0- 2	80-100	70-90	–	0- 1	0
1A	14	14	46- 58	- 4- -46	86	-63	0.5- 3	0-0.6	8-17	2- 7	2.3	30-75	5-45	1-15	0- 3	83-100	63-90	x	0- 1	0
1B	13	14	62- 67	- 1- - 6	96	-36	3.0- 5	1-3.0	15-18	8-13	3.5	70-90	25-40	10-15	1- 3	80- 95	70-85	x	0- 1	0
2	14	14	46- 57	-20- +16	86	-44	0.5- 7	Tr-3.0	8-15	1-10	6.6	10-55	5-35	2-30	0- 7	70- 95	65-85	x	0- 1	0
3	–	15	15- 25	-45- -51	36	-87	Tr- 0.1	0- Tr	8-25*	1-13*	–	40-60	30-50	2-10	0- 2	85-100	75-90	–	0	0
4	–	13	62- 74	- 1- -33	103	-81	2.0- 5	Tr-1.0	11-27	4- 9	3.8	5-45	1-20	0- 5	0- 1	60-100	40-85	–	3-10	0
4A	14	13	52- 61	0- 28	85	-37	2.0- 8	0.1-4.0	17-24	3-13	4.5	35-95	25-90	5-25	0-10	85-100	60-90	x	0- 2	0
4B	13	13	60- 67	- 1- + 5	92	-30	3.0- 5	1.0-3.0	16-22	10-14	3.0	55-85	25-40	12-15	1- 3	90- 95	75-90	x	3- 6	0
4C	13	13	61- 71	- 3- + 4	96	-50	5.0- 6	2.0-3.0	15-17	11-12	3.1	55-95	25-40	10-15	1- 3	90- 95	75-90	x	5-15	0
4D	14	13	60- 64	-15- -20	93	-51	3.0- 4	0.5-1.0	18-22	7-11	2.1	50-60	25-40	1- 2	0- 1	85-100	70-85	–	5-10	0
4E	13	13	65- 74	-13- -20	98	-61	2.0- 4	0.5-2.0	11-18	4- 7	2.1	50-60	25-40	1- 2	0- 1	85-100	40-70	–	5-10	0
4F	14	13	65- 74	-13- -27	96	-57	2.0- 3	0.4-1.0	11-13	4- 5	2.1	50-60	25-40	1- 2	0- 1	88-100	50-70	–	5-10	0
5	–	16	61- 95	- 5- +30	110	-58	1.0- 4	Tr-1.0	9-25	3-14	2.6	5-45	3-15	Tr- 4	0- T	65- 98	25-85	–	15-55	0
6A	13	13	59- 65	5- 25	92	-36	2.0-18	0.4-5.0	15-21	4-15	7.9	15-55	5-30	1- 7	0- T	85- 96	50-85	–	0- 2	0
6B	9	6	62- 75	24- 36	100	-15	6.0-14	0.5-6.0	19-25	3-16	8.1	15-60	5-35	1-10	0- T	66- 96	45-93	x	1- 9	0
7	–	12	72- 85	-15- +20	108	-70	2.0- 4	0.5-3.0	11-19	6- 9	5.3	20-60	10-40	1- 4	0- 1	55- 95	45-85	–	15-40	0
7A	13	12	56- 63	22- 24	95	-30	5.0- 7	3.0-4.0	14-18	9-12	7.0	60-90	25-40	3-12	T- 3	60- 95	65-90	x	5-10	0
7B	10	12	65- 80	10- 35	104	-30	3.0- 5	2.0-3.0	12-13	8- 9	6.4	30-60	10-30	T- 2	0- T	55- 85	52-75	x	5-25	0
8	–	11	85- 89	4- 25	114	-27	3.0- 5	0.5-3.0	11-16	5- 9	5.1	35-65	5-25	1- 4	0- T	50- 90	45-88	–	25-60	0
8A	10	11	79- 84	25- 30	104	- 9	4.0- 5	2.0-3.0	12-13	8- 9	9.2	50-65	25-30	2- 4	0- T	50- 85	45-88	–	20-30	0
9	–	7	86- 96	27- 51	111	-11	4.0- 8	1.0-3.0	9-19	4- 8	9.2	25-65	5-40	T- 7	0- 1	50- 95	40-85	–	35-90	0
9A	10	7	85- 88	32- 35	105	2	5.0- 7	2.0-3.0	12-14	7- 8	7.0	50-65	25-40	1- 5	0- T	60- 85	50-75	–	55-90	0
9B	6	7	89- 91	37- 50	105	5	6.0- 8	1.0-3.0	14-16	6- 7	7.7	20-60	5-45	T- 5	0- T	60- 95	45-90	–	45-85	0
9C	6	7	87- 93	43- 48	105	10	5.0-20	2.0-4.0	10-17	5- 6	8.1	20-60	2-35	T- 1	0- T	55- 93	50-85	–	55-90	0
10	–	10	76- 92	- 2- +24	112	-54	1.0- 3	0.2-0.6	10-17	2- 7	3.8	25-60	10-45	T- 1	0- 1	35- 90	15-70	–	2-50	0
11	–	9	88- 92	9- 18	104	-27	1.0- 2	0.2-0.5	6- 9	2- 4	2.4	10-40	2-20	T- 4	0- T	50- 85	12-75	–	13-30	0
12	–	6	90-100	35- 40	112	18	1.0- 4	0.0- Tr	9-11	0-Tr	3.5	15-40	2-20	T- 2	0	65- 95	18-75	–	4- 5	0

*Trace or more

TABLE A-4 (Cont.)

Climatic Characteristics of North America

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds				Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (Inches)		Mean No. Days With 0.01 Inches or More		Maximum Probable 24-hour Precip. (Inches)	Probable Average per cent of Time Speeds Exceed								
												10 knots		32 knots						
	Bailey	Critchfield	Maximum Warmest Month	Minimum Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month	Dampest Month	Driest Month			
12A	9	6	70- 75	37-42	102	23	3.0- 4	0.0- Tr	10-14	0-Tr	3.2	35-60	10-35	T - 3	0	70-90	60-85	x	1- 2	0
12B	7	6	70- 85	40-45	110	25	3.0- 4	0.0- Tr	7- 9	0-Tr	6.1	10-60	5-20	T - 1	0	50-95	30-75	x	1- 6	0
13	7	4	74- 85	40-47	110	25	2.0- 3	0.0-0.1	7- 8	0-Tr	3.6	5-40	2-25	T - 1	0	60-88	30-75	x	1- 3	0
14	–	4	94-106	31-42	122	- 6	0.5- 3	Tr-0.3	3- 8	Tr- 2	4.0	10-45	2-20	T - 4	0-T	30-75	10-40	–	5-40	0-50
14A	4	4	78- 95	50-56	117	35	1.0- 3	0.0- Tr	5- 7	0-Tr	6.6	30-45	15-30	1- 5	0- 1	50-85	30-75	–	6- 7	0
15	–	5	90- 99	22-50	119	-14	3.0- 5	0.1-0.7	7-13	1- 4	11.5	25-60	10-40	1- 3	0-T	40-80	20-70	–	3-40	0
15A	3	5	85- 95	53-62	106	38	6.0- 9	0.0- Tr	15-16	0-Tr	10.6	20-35	15-20	1- 2	0-Tr	70-85	40-30	–	18-30	0
15B	3	5	93- 94	47-52	104	12	4.0- 6	1.0-2.0	8-10	4- 5	8.2	50-65	15-30	1- 2	0-Tr	65-85	50-04	–	30-35	0
16	–	16	79- 93	22-44	112	2	3.0- 6	0.1-0.3	12-25	Tr- 2	2.5	5-30	2-10	Tr- 1	0-Tr	55-85	30-60	–	18-60	0
17	–	3	79- 92	47-60	104	34	7.0-11	Tr-2.0	16-23	Tr- 7	5.3	10-50	2-10	1- 6	0- 1	70-95	45-75	–	12-48	0
17A	2	3	81- 95	58-79	104	45	8.0-17	0.0-0.4	12-26	0- 1	11.3	10-60	0-20	Tr-12	0	70-99	40-85	–	10-120	0
17B	1	3	90- 91	71-72	96	64	10.0-12	Tr-1.0	23-24	1- 2	4.7	15-55	5-10	0-Tr	0	73-95	50-87	–	60-100	0
17C	6	3	90- 92	58-60	104	34	10.0-12	0.5-1.0	16-18	2- 3	7.6	45-55	20-25	0- 2	0-Tr	70-90	65-85	–	15-20	0
17D	2	3	85- 90	62-65	96	48	13.0-15	0.3-1.0	18-20	2- 3	7.7	45-50	20-25	1- 4	0	73-93	67-87	–	18-24	0
18	–	16	69- 95	40-72	101	49	6.0-20	0.1-7.0	14-25	1- 9	0.0	10-40	5-20	2- 5	0	70-90	45-75	–	10-70	0
19	–	1	84- 86	68-72	106	52	10.0-14	1.0-2.0	18-25	3-14	–	15-30	5-10	0-Tr	0	80-98	70-85	–	15-30	0
19A	1	1	88- 90	65-67	106	50	18.0-20	1.0-2.0	18-24	2-10	7.7	45-55	25-35	0- 1	0	82-96	70-90	–	20-30	0
19B	1	1	87- 91	63-73	99	54	17.0-22	2.0-5.0	19-25	3-12	11.2	15-80	5-25	0-Tr	0	80-98	60-85	–	17-100	0
20	–	3	90- 92	63-65	104	45	7.0- 8	1.0-2.0	13-16	2- 3	3.5	35-50	5-20	0- 1	0	78-94	60-75	–	15-25	0
20A	2	3	86- 88	66-68	99	54	6.0- 9	0.1-1.0	16-19	1- 3	2.6	45-55	30-35	0- 1	0	80-95	65-90	–	30-35	0
20B	2	3	88- 90	66-68	99	49	7.0- 8	0.5-1.0	12-15	2- 3	9.0	50-60	20-30	0- 1	0	78-94	70-85	–	20-25	0
21	3	5	86- 92	66-68	106	51	3.0- 7	0.5-1.0	8-15	1- 2	4.1	45-55	20-30	1- 2	0	70-95	53-85	–	6-10	0
22	2	3	88- 90	57-70	95	28	4.0-12	1.0-2.0	14-17	4- 6	5.0	30-55	10-45	Tr- 1	0	70-85	60-75	–	25-75	0
23	1	3	84- 86	60-65	98	48	8.0- 9	1.0-2.0	13-16	3- 4	5.0	25-35	10-30	Tr- 1	0	80-95	70-90	–	50-70	0
24	2	3	84- 91	61-65	102	45	6.0-10	0.5-2.0	12-16	2- 7	7.0	30-45	5-30	Tr- 1	0	60-92	45-80	–	5-100	0
25	1/2	3	90- 92	67-69	98	55	7.0-10	0.5-1.5	11-15	1- 4	7.0	20-40	10-20	Tr- 1	0	70-85	55-75	–	50-65	0
26	1/2	2	85- 87	68-70	94	60	5.0- 7	2.0-3.0	15-21	8-14	7.0	30-45	15-25	0-Tr	0	74-90	68-85	–	12-20	0

TABLE A-5

Climatic Characteristics of Australia, New Zealand and Southwest Pacific Islands (Oceania)

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds				Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Dust- or Sand-storms
			Daily Mean		Probable Absolute		Mean Monthly (inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed								
												10 knots		32 knots						
	Bailey	Critchfield	Maximum, Warmest Month	Minimum, Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month	Dampest Month	Driest Month			
1	–	3	98-102	52-56	112	36	8-10	Tr-0.1	12-15	0- 1	8.0	20-50	5-10	0- 1	0	55-85	35-75	–	70-100	0
1A	2	3	95- 97	52-55	108	36	13-15	Tr-0.1	13-16	0- 1	7.8	25-40	5-15	Tr- 2	0	60-80	40-50	–	90-100	0
1B	3	3	96- 99	62-66	112	50	6- 8	Tr-0.1	13-16	0- 1	5.9	25-30	5-10	0-Tr	0	55-75	35-40	–	70- 80	0
1C	2	3	92- 96	65-70	105	56	10-16	Tr-0.1	16-20	0- 1	9.2	25-65	5-15	0- 1	0	75-90	45-80	–	70- 80	0
2	–	3	92-100	60-65	105	35	9-11	Tr-0.2	15-20	0- 1	12.0	30-45	5-10	0-Tr	0	70-90	35-70	–	20- 40	0
2A	2	3	89- 92	57-60	103	44	10-12	Tr-0.2	15-20	0- 1	10.4	45-55	10-20	0-Tr	0	70-90	40-70	–	20- 40	0
2B	1	3	89- 92	58-61	110	43	16-18	1.0-2.0	18-20	4- 7	8.0	35-50	5-10	0-Tr	0	65-90	55-80	–	7- 12	0
3	–	5	90-102	38-54	128	24	2- 7	0.1-0.3	6-12	Tr- 4	8.0	25-50	10-30	0-Tr	0	30-85	20-50	–	10- 40	0
3A	3	5	93- 95	55-60	111	40	7- 8	0.1-0.2	9-11	0- 1	13.8	35-50	10-20	Tr- 2	0	65-90	30-75	–	20- 40	0
3B	3	5	90- 93	60-65	105	45	8- 9	0-Tr	10-12	0-Tr	9.0	40-45	10-15	0-Tr	0	65-90	40-75	–	20- 25	0
3C	12	5	78- 82	43-45	123	25	1- 2	0.3-0.5	10-11	2- 4	4.5	60-65	35-40	3- 4	Tr-1	55-90	50-75	–	3- 10	0
3D	4	5	85- 88	52-53	116	33	2- 5	Tr-0.2	6-14	Tr- 1	4.5	70-75	35-45	1- 5	0-Tr	55-85	40-90	–	5- 10	0
4	–	7	90- 95	34-38	117	20	2- 5	1.0-2.0	7-12	4- 5	5.0	30-45	10-35	1- 4	0-Tr	60-90	35-75	–	15- 30	0
4A	2	7	86- 88	60-62	110	45	9-11	0.5-1.0	12-14	1- 2	10.3	35-40	10-20	Tr- 1	0	70-95	50-85	–	15- 20	0
4B	6	7	78- 90	45-52	114	33	5- 8	1.0-3.0	12-14	5-10	8.0	40-50	20-45	1- 5	0-Tr	60-95	45-90	–	20- 40	0
5	–	8	77- 91	34-38	117	18	2- 3	1.0-2.0	7-20	4- 7	3.9	30-55	10-40	1- 7	0-1	70-95	35-85	–	10- 15	0
5A	6	8	71- 79	43-47	114	27	2- 4	2.0-3.0	16-17	8- 9	4.6	45-65	40-50	4- 8	Tr-2	70-90	50-85	–	10- 15	0
6	–	6	86- 90	41-44	124	24	1- 3	0.4-1.0	8-10	2- 4	4.6	40-55	10-40	2- 5	0-1	55-80	35-65	–	10- 15	0
6A	7	6	78- 90	44-46	119	31	1- 3	0.4-1.0	8-17	3- 5	5.6	55-65	35-45	3- 7	Tr-1	55-85	35-65	–	10- 16	0
7	–	6	88- 94	40-45	116	26	2- 4	0.3-1.0	12-15	2- 4	4.0	40-65	25-40	3- 9	0-1	65-90	30-60	–	10- 15	0
7A	7	6	74- 85	45-52	117	31	4- 8	0.3-1.0	16-25	3- 7	5.0	55-75	45-55	4-12	Tr-2	65-90	45-80	–	13- 16	0
8	–	4	90-102	38-46	119	19	0.5-2	0.1-0.6	2- 7	1- 3	5.0	20-50	5-30	0- 1	0	30-90	20-65	–	5- 15	0.5
8A	4	4	88- 95	52-55	116	37	2- 3	Tr-0.2	5- 7	Tr- 1	4.8	45-75	20-40	Tr- 3	0	50-85	45-75	–	15- 25	0
9	8	8	66- 69	44-45	93	28	4- 6	1.0-3.0	22-23	10-12	4.2	60-70	30-45	3-10	Tr-1	78-90	64-85	–	5- 8	0
10	10	8	71- 74	35-41	105	19	2- 3	1.0-2.0	17-18	8-10	5.0	55-70	30-45	1- 8	Tr-1	70-92	50-68	–	3- 6	0
11	8	8	64- 67	34-39	85	23	8-25	6.0-10.0	18-27	10-20	6.3	55-80	45-65	2-11	Tr-5	80-95	70-80	–	10- 25	0
12	10	8	66- 79	34-42	97	17	3-11	1.0-3.0	14-21	5-16	3.5	45-75	35-55	3-13	Tr-4	70-95	55-85	–	3- 20	0
13	6	8	73- 77	40-46	90	27	6- 7	2.0-3.0	18-21	7-11	2.2	45-65	35-40	1- 7	0	70-90	60-80	–	4- 20	0
14	1	3	86- 88	55-61	99	52	5-20	1.0-6.0	9-18	3-13	-	50-55	25-40	2- 5	0	70-90	60-80	–	1- 4	0
15	1	1	84- 89	65-72	94	54	10-27	3.0-16.0	22-26	9-21	-	40-55	20-30	Tr- 1	0	70-95	65-90	–	10- 30	0
16	1	–	86- 90	65-70	99	40	10-15	1.0-2.0	18-21	3- 5	-	50-55	25-30	0-Tr	0	70-95	55-88	–	20- 30	0
17	1	–	80- 86	57-68	98	40	15-27	3.0-6.0	20-25	7-18	-	50-55	25-35	0-Tr	0	75-95	68-90	–	25- 35	0

TABLE A-6

Climatic Characteristics of Antarctica

Zone	Climatic Classification		Temperature (°F)				Precipitation					Wind Speeds				Probable Mean Relative Humidity Range (per cent)		Fog on Coast (Bailey)	Mean Annual No. Days With Thunder-storms	Mean Annual No. Days With Blowing Snow
			Daily Mean		Probable Absolute		Mean Monthly (inches)		Mean No. Days With 0.01 inches or More		Maximum Probable 24-hour Precip. (inches)	Probable Average per cent of Time Speeds Exceed								
												10 knots		32 knots						
	Bailey	Critchfield	Maximum, Warmest Month	Minimum, Coolest Month	Max.	Min.	Wettest Month	Driest Month	Wettest Month	Driest Month		Highest Month	Lowest Month	Highest Month	Lowest Month	Dampest Month	Driest Month			
1	14	15	25- 35	-25- -40	42	-58	0.5-3.0	0.1-1.0	13-15	6- 8	–	50-80	40-65	8-12	0- 6	0	0	0	0	128
2	14	14	30- 37	-20- -30	45	-50	0.5-3.0	0.1-1.0	-	-	–	75-85	30-65	10-12	1- 7	0	0	0	0	0
3	14	14	30- 37	-10- -20	—	—	0.5-3.0	0.1-1.0	15-31	12-16	–	55-80	35-65	7-12	3- 5	0	0	0	0	0
4	14	15	25- 35	-10- -30	—	—	0.5-3.0	0.1-1.0	-	-	–	65-75	50-60	5-15	3- 7	0	0	0	0	0
5	14	15	25- 35	-25- -35	—	—	0.5-3.0	0.1-1.0	-	-	–	60-65	20-55	5-12	3- 7	0	0	0	0	0
6	14	14	30- 36	- 4-+26	—	—	3.0-4.0	0.5-1.0	14-21	5-17	–	50-70	40-50	6-10	3- 5	80-88	53-84	0	0	0
7	14	14-15	25- 35	-15- -35	—	—	0.5-3.0	0.1-1.0	-	-	–	60-75	50-60	5- 8	3- 5	0	0	0	0	0
8	–	15	0-+10	-40- -60	10	-100	0.5-2.0	Tr-0.5	-	-	–	80-95	40-60	15-30	0-10	0	0	0	0	0
9	–	15	-10- -20	-40- -70	- 5	-125	0.1-0.5	0.0-0.2	-	-	–	50-90	15-30	2-10	0- 2	0	0	0	0	0

APPENDIX B

NATURAL ENVIRONMENT OF CONTINENTAL AREAS

APPENDIX B

NATURAL ENVIRONMENT OF CONTINENTAL AREAS

This appendix contains the background data for overland operations of Ground Effect Machines. These data represent some of the essential parameters of military geography, with particular emphasis on the elements affecting GEMs. The elements tabulated in Tables B-1 through B-7, and their classifications have been discussed in Chapter I (Volume I), together with summaries of the data.

Assembly and classification of military geography data for overland operations on a world-wide basis is a task of major proportions. Some areas, such as Western Europe and the United States, are covered by a multitude of geographic data. Other areas, such as central Asia and Eastern Africa, have been mapped and studied only on a very general basis. Even for the areas with complete coverage, geographic elements have commonly been discussed in descriptive terms unsuited for numerical classification or determination of vehicle (system) design and performance requirements.

The published sections of the National Intelligence Survey series have provided, for the first time, coordinated material on military

geographic elements. In particular, the Sections 21 and 24 of the NIS series covering Military Geographic Regions and Military Topography have provided largely comparable data, with some numerical factors, on the primary military geographic elements for large areas of the world.

These NIS data have been used for the published areas. In some of these areas, the data are not as complete as desired, but considered to be the best available. Areas of the world not covered by NIS have been analyzed in terms of many other data sources. These sources have included the Department of Engineer Intelligence of the Army Map Service; the Military Geology Branch of the Department of the Interior; the facilities of the National Geographic Society; and numerous commercial atlases and geography texts. A few special study reports on specific areas were obtained through the Armed Services Technical Information Agency.

Data from all these sources were assembled on a consistent basis within the framework discussed earlier in this section. In a few areas data are missing, and the further intensive research required to fill in these blanks was not considered economical within the objectives of the study. The following notes will assist in understanding the form of data presentation.

(1) The geographic data are tabulated in terms of political units. Occasionally, several political units situated in a single geographic area are considered together, as for example, Norway and Sweden. In a very few cases, large political units, e.g., U.S.S.R., are divided into several subareas for convenience of presentation. Political units are arranged by continents, with the further breakdown of Eurasia into Europe without U.S.S.R.; U.S.S.R.; and Asia without U.S.S.R., as discussed in Chapter I.

(2) Political units are divided into climate zones on the basis discussed in Chapter I, Section 2, (Volume I), to facilitate coordination of all the climatic and environmental data for a given area. Since the climate zones tend to have some degree of homogeneity, this breakdown provides a better indication of the predominant characteristics in a given area. Where a numerical or descriptive data element applies to the combination of two or more climate zones within a political unit, it is indicated by brackets or a vertical arrow (↓).

(3) The complete data for each area are contained on two successive pages. The climatic correlation is given on the first page, with the zone number and zone area repeated on the second page for identification.

(4) Altitude distribution, slope distribution, and vegetation and surface cover distribution are given as percentages of the total area of the data unit. The asterisk in the altitude distribution tabulation indicates land below sea level. All slopes are given in percentage gradient, which should not be confused with angles given in degrees. For example, 10 per cent slope ~ 6°, 30 per cent slope ~ 17°, 100 per cent slope = 45°.

(5) The data on stream valleys indicate typical spacing between streams, the mean water width, and the percentage of stream mileage having steep banks (defined approximately, as vertical and over 10 feet high, or 100 per cent slope and greater than 15 feet high--this is <u>not</u> a precise number).

(6) Superscripts in the tabulation of vegetation and surface cover distribution indicate the height in feet of the pertinent feature. For cultivated crops, this is usually the maximum height during the growing season.

(7) The cross-country index, as given, is only a convenient number for indicating the most significant obstacles to cross-country operation. It is given in terms of the cross-country capability of conventional tracked vehicles with ground pressures of 12-15 psi. In each case the percentage of unsuitable area is given, and the primary cause or causes are listed.

(8) Special features re GEMs include other geographic features, natural or man-made. An effort has been made to include pertinent numbers on size and distribution of these features. Where not otherwise identified, drainage ditches, canals, etc., are listed by height and width in that order, e.g., 2 x 5 feet means 2 feet deep, 5 feet wide at surface. The discussion of Chapters I and II (Volume I) includes most of the features listed in the tabulation.

(9) Missing data, or data whose values are not known well enough to be usable, are indicated by question marks.

(10) Even though the data units represent specific areas of world land masses, the data for each data unit represent only the most common ranges of parameters throughout the unit. Any individual location may fall outside of some of the ranges. Therefore these data cannot be used to support or reject an operation at any particular location. Further study of the area in question would be required to obtain sufficient detailed data.

TABLE B-1

Natural Environment of Europe (without USSR)

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
U. K.	93.9	49	93.9	100	Lowlands and undulating hills, mtns N	78	20	2			70	15	15	10-15	50-200	Few
Ireland	27.1	49	27.1	100	Rolling hills, scattered mtns	90	10	neg			75	15	10	15	2/3 <75	In mtns
Iceland	39.8	55	6.6	15	Rugged volcanic terrain with glaciers	70	25	5			35	35	30	10-30	Broad and shallow	At edge of plateau
		56	33.1	85		46	40	12	2		25	40	35	10-30		
Norway, Sweden	322.7	1	22.6	7	Rugged glaciated mtns, with forested lowlands S and E, numerous lakes E, fiords W	40	50	10	neg		20	50	30	Numerous small streams	Major rivers >100	Mostly
		2	122.8	38		45	50	5	neg		30	40	30			
		51	96.8	30		70	25	5			45	35	20			
		52	16.2	5		10	50	40	neg		5	10	85			
		53	16.2	5		15	50	30	5		2	8	90			
		54	48.4	15		25	65	10	neg		5	15	80			
Finland	130.1	2	130.1	100	Forested lowlands many lakes and streams	90	10				90	10		10		Few
Denmark	16.6	48	16.3	100	Numerous islands flat to rolling hills	100					95	5		5-15	<50	Few

*Below sea level

Confidential

TABLE B-1 (Cont.)

Natural Environment of Europe (without USSR)

Confidential

Data Division	Climate Zone	Zone Area ($1000 mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
U. K.	49	93.9	Some coastal marshes	5	30	15	50[3]			25	Rugged and marsh	Stone and turf walls, 2-6 ft hedges 4-15 ft, dense urban areas
Ireland	49	27.1	Many marshes inland	2	33	35[3]	15[3]	15		25	Hills and marsh	Walls 5 ft, hedges 12 ft
Iceland	55	6.0	Glaciers and icecap, falls and rapids on streams	neg	1/3 brush and heather	3-4	neg		2/3 icecap and rock	80	Rugged, icecap	Boulders, rough lava flows
	56	33.8		neg	1/3 brush and heather		neg		2/3 icecap and rock	80		
Norway, Sweden	1	22.6	Long narrow lakes east of mtn ridge, falls on rivers, many fiords	neg		50	neg		50 ice field and	75	Rugged and forested	Fiords to 125 miles inland, icecaps, steep walled valleys in west, islands are rugged
	2	122.8		65			5	25	5 ice field rock	75		
	51	86.8		70			20	10		75		
	52	16.2		40			10		50 ice field rock	75		
	53	16.2		60					40 ice field rock	75		
	54	48.4		50				5	45 ice field rock	75		
Finland	2	130.1	Falls and rapids on all major rivers in north, lakes and swamps frequent	57			10	29	4 tundra	70	Forested and swamp	Eskers slopes 50-70 per cent, 3-4 miles in south
Denmark	48	16.6	Many coastal streams canalized, 30 ft wide	8		10[3]	75[4]	2	5 dunes	50	Dunes, marsh, soft ground	Walls flank most roads, earthen banks 6-10 feet ditches 2-5 feet deep, 20-30 feet wide

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-1 (Cont.)

Natural Environment of Europe (without USSR)

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Belgium, Netherlands, Luxembourg	25.3	48	25.3	100	Flat N and W, partly reclaimed land, hills E and S	80 *12	8				75	20	5	10-25	Mostly >60	Few
France (including Corsica)	212.7	43 44 45 48	8.5 21.3 12.8 170.3	4 10 6 80	Broad lowland with central plateau and rugged mtns S and SE border	40 10 40 65	30 40 40 30	30 35 15 5	neg 13 5 neg	 2 	10 20 40 70	30 10 20 20	60 70 40 10	10-30 10-30 10-30 10-30	30-250	In mtns
Portugal, Andorra, Spain	230.6	45 46 47 48	46.1 92.3 34.6 57.6	20 40 15 25	High plateau, narrow coastal plain, mtns N and scattered throughout	40 5 60 15	35 55 35 45	20 35 5 35	5 5 5	neg neg	50 40 30 40	20 40 45 25	30 20 25 35	15-40 15-40 15-40 15-40	2/3 <50 5 rivers >100)	2/3
Germany (W and E)	137.5	44 48 50	16.5 82.5 38.5	12 60 28	Broad plains, scattered forested hills, mtns on S border	5 70 50 *neg	75 30 49	20 neg 1	neg		35 45 50	30 45 35	35 10 15	20-40 20-40 20-40	>30 5 major rivers	In highlands and Rhine tributaries
Poland	120.4	50	120.4	100	Mostly level plain, rugged mtns S and SW border	90	9	1	neg		80	15	5	25-40	Mostly >40	30 per cent in S

*Below sea level

Confidential

TABLE B-1 (Cont.)

Natural Envrionment of Europe (without USSR)

Confidential

Data Division	Climate Zone	Zone Area ($1000 mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEMs
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Belgium, Nether-lands, Luxem-bourg	48	25.3	Numerous canals and ditches, canals 40 ft wide, steep banks	20 Scattered			80[4]	All Drained		50	Irrigation features, forested slopes	Drainage ditches: 3-4 ft deep by 4-8 ft wide others 5 ft deep, 15 ft wide, or 6 ft deep, 30 ft wide Larger canals ▲ 2-5 miles many dikes 3-5 ft high coastal dikes 15-20 ft high dense urban areas
France including Corsica	43 44 45 46	8.5 21.3 13.8 176.3	Canals 30 to 200 ft wide earthen banks 30-50 per cent slope	10 30 20 20	70[10] 30 20 10		20[5] 40 60 70			15 15 15 15	Mtn and rugged	Hedges on 3-5 ft earth banks line roads and fields, dense urban areas
Portugal, Andorra, Spain	45 46 47 48	43.1 92.3 34.6 57.6	Escarpments border some inland rivers slopes 30-100 per cent	20 25 30 25	15[4] 15 30 30	30[2] 10 5	35[4-5] 50 40 40			40 40 40 40	20 steep 5 wet 15 dissected hills	Ditches in irrigated areas 2-5 ft deep, 2-5 wide artificial terraces for hill cultivation
Germany (W. Zone)	44 45 46	16.5 82.5 38.5	Broad and deep rivers ice 15 days NW to 45 days E	50 20 25	10 5 10	15 5 5	25 65 60		5 sparse heath	30 30 30	10 ditches and bog 5 mtn 15 forest	Ditches and dikes to 10 ft in N, hedgerows and rail embankments, extensive built-up areas
Poland	50	120.4	Frozen part-time December - March	25			50[5]	15 Lake and Stream		5	Mtn and scattered forest	

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

TABLE B-1 (Cont.)

Natural Environment of Europe (without USSR)

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Czechoslovakia	49.4	42	12.4	25	Rolling and hilly, western basin rimmed by mtns	50	30	18	2		50	40	10	30-40	2/3 > 75	Alternating steep and gentle
		50	37.0	75		50	45	5			60	30	10	30-40	↓	
Switzerland, Austria, Liechtenstein	46.4	42	9.7	20	Rugged Alps, scattered lowlands, many lakes	10	50	30	10		15	50	35	15-25	25-175	Mostly, slope 35 - 100 per cent
		44	26.6	55			45	20	25	10	10	20	70	15-25		
		50	12.1	25		30	50	15	5		20	45	35	15-25	↓	
Italy (including Sicily and Sardinia)	116.3	42	17.5	15	Central mtn core, Po Valley, Alps N	neg										
		43	81.4	70		75	15	5	5		65	15	20	10-40	60-250	In mtns
		44	17.5	15		25	50	20	5		60	20	20	10-40	N only (others small)	
						10	40	30	15	5	15	15	70	10-40		
Hungary, Albania, Yugoslavia	145.8	41	51.0	35	Rugged karst topography W, broad plain NE	30	20	45	5		15	25	60	30-60	100 300	1:3
		42	94.7	65		75	15	10	neg		55	25	20	Hungarian plain		
Greece (Including Islands)	51.2	41	51.2	100	Rugged hills and mtns, many islands	50	35	10	5		20	40	40	10-30	2/3 > 25	Mostly, 25-ft banks comm on
Romania, Bulgaria	134.5	39	13.4	10	Mtns W, Danube plain E	70	30	neg			65	15	20	15-30	50-200	In mtns
		42	121.1	90		65	20	11	4		70	10	20	15-30	↓	

*Below sea level

Confidential

TABLE B-1 (Cont.)

Natural Environment of Europe (without USSR)

Confidential

Data Division	Climate Zone	Zone Area (1000 mi^2)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Czechoslo-vakia	42 50	12.4 37.0	Marshes in S	35 30		10 15	50[5] 45	5 10		35 35	Forested mtns ↓	Ditches in lowlands 3-10 ft. deep, may be dry
Switzer-land, Austria, Liechten-stein	42 44 50	9.7 26.6 12.1	Large lake areas, some glaciers	35 35 25		35 40 30	30 15 40	 10 5	 Some rock and ice	70 70 70	Mtns ↓ ↓	Rugged Alps pierced by rail tunnels, roads in mtns 13-22 ft wide
Italy (including Sicily and Sardinia)	42 43 44	17.5 81.4 17.5	Falls and rapids in Alps, streams in S sometimes dry	5 15 60		25 30 20	70 55 20	 	 Some rock	50 50 50	Steep slopes ↓ ↓	Ditches and canals, 2 x 2 ft to 3 x 30 ft, banks 100 per cent Po Valley wide and densely populated, stone walls 5-6 ft
Hungary, Albania, Yugosla-via	41 42	51.0 94.7	No rivers in karst area - 1/2 zone 41	40 15	30 5	20 5	10[3-7] 75	 	 	50 50	Mtns and karst area	Rail embankments in lowlands, ditches 1-4 x 1-6 ft
Greece (including Islands)	41	51.2	Numerous inlets, mtn. rivers in gorges	15	30[3-10]		25	5	5 per cent barren	70	Mtns	Cultivated terraces 2-4 ft walls, steps 10-100 ft wide
Romania, Bulgaria	39 42	13.4 121.1	Danube has high bluffs, alternating with wide flood plain	30 25	20 5	5 10	45 50	 10	 	35 ↓	Mtns and flood plain	Embankments for roads and rail along rivers

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

TABLE B-2

Natural Environment of USSR

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	>30%	freq. (mi.)	width (feet)	steep banks?
USSR (A)	1,694	1	84.7	5	90 per cent east European plain, highland and mtn fringe S and E	70	30				65	5	10	40-200	Marshy	-----
		2	593.0	35		95	4	1			95	4	1	80-200	>250	Few
		7	169.4	10		97	2	1			70	25	5	100	>250	Few
		50	847.0	50		87	3				90	10	neg	100-250	>250	Few
USSR (B)	159	7	58.8	37	Caucasus Mtns *5	65	30				95	5		20-50	<150	In Mtns
		33	47.7	30	*3	30	20	20	27		55	30	15	20-50	Mostly	In Mtns
		36	52.5	33		10	25	30	30	5		10	90	30-50	Mostly	In Mtns
USSR (C)	1,246	7	311.5	25	Mostly dry, rolling lowland	5	50	45			50	40	10	>100	Mostly	Most
		29	186.0	15	mtns in SE, and NE and SW	-	6	60	30	4	18	20	62	20-100	Narrow	Most
		33	249.2	20	borders *1	93	4	2	neg		80	10	10	>100		Most
		35	498.0	40	*6	84	10				90	10		>100		Most
USSR (D)	1,890	2	1101.0	63	Colc plains, mtns W and SE	90	4	5	1	neg	90	7	3	30-60	1/2 >200	In mtns only
		7	226.7	12		40	30	25	5		85	15	5	30-60	1/2 >200	In mtns only
		50	472.5	25		95	4	1			96	3	1	30-60	1/2 >200	In mtns only
		(1 incl. in 2)														
USSR (E)	3,561	1	549.0	15	3/4 hills and mtns	96	4	neg			80	15	5	Small streams	90 per cent	Mostly
		2	2930.0	80	1/4 frozen plain	65	28	5	2		30	40	30	5-20	<250	
		5	183.1	5		80	15	4	1		30	30	40	Large rivers 40-200	>250	Mostly
		(3, 4, 7, incl. in 2)														

* Below sea level

*NOTE: The USSR is divided into five geographic regions for data organization. Regions A and B make up "European" USSR, and regions C, D, and E make up "Asiatic" USSR, although these terms are no longer in general use. The breakdown is approximately as follows:

REGION A - Eastern European Russia, Baltic States, Ukraine.

REGION B - The Caucasus.

REGION C - The Central Asian Arid Lands South of 50° North Latitude.

REGION D - The Ural Mtns and West Siberian Lowland East to the Yenisey River.

REGION E - The Central and Eastern Siberian Uplands from the Yenisey to the Pacific Ocean.

TABLE B-2 (Cont.)

Natural Environment of USSR

Confidential

Data Division	Climate Zone	Zone Area (1000 mi^2)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
USSR (A)	1	84.7	Frozen Nov-May, N Dec-Feb, S					10	90 Tundra	90	Marshy	Some steep gullies in plains, permafrost NE and islands
	2	593.0		80			5	5	10 Tundra	90	Forest	
	7	169.4	large marshes in W and			15	75		10 Semi-desert	10	Dissected plains	
	50	847.0	central	40		5	50	5		20	Forest	
USSR (B)	7	58.8	Marshes NE, also irriga-	5		20	60	15		15	Marsh	Irrigation canals and levees 10 feet high
	33	47.7	tion ditches,	20		35	40	5		40	Mtns, marsh	
	36	52.5	N frozen Dec-March	40	30	20			10 Alpine	90	Mtns	
USSR (C)	7	311.5	Many streams dissipate	1	2[15]	27[3]			70 barren	15	Mtns and	Irrigation ditches on rivers in dry areas lined with trees, sandstorms in desert
	23	186.9	in desert, rivers and	3	7		5[4]	35	50 barren	15	scattered marsh	
	33	249.2	lakes freeze Nov-March,		1	80	4		15 barren	15		
	35	498.0	several large lakes		3	85		7	5 barren	15		
USSR (D)	2	1101.0	Ob and Yenisey systems	50	5	5[3]	5	20	15 Tundra	60	Forest, marsh	Permafrost N 1/3
	7	226.7	drain entire area, falls	10	10	30	45		5 Semi-desert	35	Mtns	
	50	472.5	and rapids in mtns,	20	15	20	20	25		50	Marsh	
	(1 incl in 2)		frozen Nov-May with rough surface									
USSR (E)	1	549.0	Numerous bogs and			20[3]		5	75 Tundra	75	Mtns, forest,	Icings through frozen ground--ridges 3-30 feet high, 40-200 feet across, permafrost continuous N of 64°
	2	2930.0	marsh N of 60°, frozen		45	30	5	5	15 Bare	75	marshes	
	5	183.1	Nov-May ice jams in	75			10	10	15 Bare	75		
	(3, 4, 7 incl. in 2)		spring									Tundra passable in winter only

* See note on preceeding page

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-3

Natural Environment of Asia (without USSR)

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	>30%	freq. (mi.)	width (feet)	steep banks?
China (A)	2,553	7	1063.0	45	High mtns, bordering broad basins, mostly barren desert and grass-lands	neg	15	55	25	5	45	30	25	Inter-mittent	Braided	Few
		12	104.6	4				10	70	20		5	95			Few
		29	933.5	36					4	96	30	15	55	Small streams only		> 1/2
		30	369.0	15		1	55	40	4	neg	40	45	15	Few	?	
		(2 and 6 incl in 7) (8 incl in 29)														
China (B)	558	5	306.9	55	Central lowland bordered by hills and mtns, except S	40	56	4	neg		70	30	neg	30 - 100	2/3 > 250	In mtns
		6	251.0	45		70	22	8	neg		65	30	5	40 - 100	2/3 > 150	In mtns
		(2 and 7 incl in 5)														
China (C)	339	7	118.7	35	Rugged mtns W, flat low plains E	30	10	45	15		30	20	50	40 - 80	> 60	1/2
		8	220.3	65		40	20	20	16	4	40	20	40	15 - 80	> 60	1/2
China (D)	1,035	12	880.0	85	3/4 hills and mtns, very rugged in W, plain NE, karst area W central	50	35	12	3	neg	30	25	45	25 - 100	? Several major rivers	Most, except in plains
		21	155.0	15			5	5	30	60		10	90	?		
		(13 incl in 12) (29 incl in 21)														

*Note: The following regional breakdown is used:
China (A) - western China, Sinkiang, Mongolia, Tibet
China (B) - northern China, including Manchuria
China (C) - east China, N of 33°
China (D) - south China, including Taiwan, Hainan, Hong Kong

*Below sea level

Confidential

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Climate Zone	Zone Area (1000 mi^2)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEMs
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	% unsuit-able	Cause	
China (A)	7	1066.0	Many summer marshes in Mongolian Basin, stream s frozen Nov-March	3	4[15]	40	3		50 sparse and desert	60	Mtns and min basins	Frequent dust storms on plains, dune lee slopes to 60 per cent, intermittent wall E third of S border
*	12	103.6		25	20	40	15		85 sparse	60	↓	
	29	933.5		3		12			90 sparse	60		
	30	389.0			10					60		
	(2 and 6 incl in 7) (8 incl in 29)											
China (B)	5	306.9	Rivers frozen Dec-March, extensive marshes E	60		15[3]	15[3]	10[10]		35	25 mtns, 5 marsh	Rivers have even surface when frozen, wall SW border 250 mi
	6	251.0		15	5	30				35	↓	
	(2 and 7 incl in 5)											
China (C)	7	118.7	Yellow R. drainage, large flood plain E 1/3, several prominent canals 60 ft wide			65[3]	35			65	Steep, loess-lands, flooded paddies	Canals and ditches in rice-fields 1-2 x 10, rails and roads on embankments 3-6 ft, ricefield dikes 1-3 x 2-4, flood dikes 25-40 ft high in E third, wall N boundary 12-16 ft 1000 mi
	8	220.3		5	10	25	60			65	↓	
China (D)	13	880.0	Yangtze drainage flood plain NE, canals narrow to 30 ft at bridges	5	80[5]					65	Steep and rugged	Ricefields NE and on terraced hills, many ditches to 50 ft wide, dikes 1-2 x 2-4, dikes 10-40 ft on rivers, conical grave mounds in rural areas 6-15 ft high,
	21	155.0		40	60		15			65	↓	Taiwan: 50 per cent slope greater than 30 per cent, 25 per cent forest, 25 per cent cultivated, Rivers steep and fast
	(13 incl in 12) (29 incl in 21)											

* See note preceeding page.

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Area (1000 mi^2)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi^2)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Korea - N	49.1	6	49.1	100	85 per cent highlands, coastal plain W	30	40	20	10		20	20	60	5 - 15	2/3 > 40	Most
Korea - S	37.5	6	37.5	100	70 per cent highlands, coastal plain W	60	38	2			20	20	60	5 - 25	> 40	Most
Japan	142.8	9	49.9	35	Rugged islands, few low-lands, densely cultivated wherever possible	30	60	8	2	neg	20	30	50	20 - 50	2/3 > 100	Most
		10	49.9	35		35	60	4	1		40	20	40	20 - 50	2/3 > 100	Most
		11	42.8	30		25	65	5	4	1	20	20	60	20 - 50	2/3 > 100	Most
Indochina (incl N and S Vietnam, Cambodia, Laos)	287.5	12	63.3	22	Mtns and hills, N and S central, major escarp-ment on Thailand border 1-3000 ft high (240 mi)	50	30	10	10		20	30	50	15 - 40	< 25	Most
		20	23.0	8		50	30	15	5		10	30	60	15 - 50	< 25	Most
		21	201.2	70		60	30	6	4		50	15	35	20 - 80	< 25	Most
Thailand	198.3	21	119.1	60	Rugged mtns NW and W half peninsula, rolling plateau E, central plain	90	8	1	1		70	20	10	20 - 50	30 - 400	Few
		22	39.7	20		95	5	neg			50	30	20	20 - 50	Small	All
		24	39.7	20		60	30	10	neg		20	20	60	30 - 60	> 30	Most

*Below sea level

Confidential

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Climate Zone	Zone Area ($1000 mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEMs
				Dense Forest	Brush Woods	Grass-lands	Cultivation	Marsh, Lake, Swamp	Other Vegetation	%unsuitable	Cause	
Korea - N	6	49.1	Frozen 3-4 months numerous small streams	30	50		20			80	Rugged	Dikes on cultivated paddies 1-3 ft, river levees to 20 ft, roads and railroads on embankments in lowlands
Korea - S	6	37.5	Numerous small streams, diked in lowlands	25	50		25			70	Rugged	See: Korea - N
Japan	9	49.9	Dams on many rivers	65	15[10]		10		10 urban and roads	75	Mtns, forest	Dense urban areas in plains, irrigated ditches 2 ft deep, also 3-8 x 4-12, wide dikes 1-3 ft high, terraced hills 5-10 ft walls
	10	49.9	30-40 mi inland, levees	60	5		20		15 urban and roads	75	↓	
	11	42.8	along lower courses	70	10		10		10 urban and roads	75		
Indochina (incl N and S Vietnam, Cambodia, Laos)	12	63.3	Mekong R. drainage, extensive flood plain and marsh S, many rapids on Mekong and tributaries	40	40		20[4]			75	Mtns, forest, swamp	Dikes in rice paddies 2 ft high, 3 ft wide, levees in river deltas to 12 ft, irrigation ditches 4 x 5 ft, 90 per cent of forests in mtns
	20	23.0		65	30		5			75	↓	
	21	201.2		60	20	5[5]	10	5		75		
Thailand	21	119.1	Large flooded and paddy area, many canals in central plain, 10-15 x 120 ft ▲ 3-6000 ft 8-10 x 60 ft ▲ 1,5-2000 ft, locks at canal junctions with rivers	50	5[16]	5	40			50	Slopes, paddies	Ricefield dikes 2 x 2, drained in fall and winter, moats and walls around cities to 15 ft high, rail and road embankments in low areas.
	22	39.7		75			25			80	Slopes, paddies	
	24	39.7		70	10		20 (85 per cent rice)			80	Mtns	

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Area (1000 mi^2)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi^2)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Burma	261.6	21	91.6	35	Forested mtns on W, N, and E borders, large wet plain center	70	20	5	5		40	20	40	40	2/3 > 175	Some
		24	117.1	45		30	30	30	10		20	20	60	?	Narrow	Most
		25 (29 incl in 26)	52.4	20		50	30	10	5	5	30	20	50	?	Narrow	Most
Northern India and Pakistan (incl Nepal and Bhutan)	1200	25	240.0	20	Rugged mtns N, desert west, central E-W plain, plateau S	50	45	5			40	40	20	25 - 50	1/3 > 750	All, (>20 ft)
		28	240.0	20		90	6	3	1		80	15	5	10 - 50	1/2 > 750	All, (>10 ft)
		29	240.0	20			10	5	20	65		5	95	Mtn streams		All
		31	180.0	15		95	5	neg			65	30	5	30 to intrq.	< 750	Some
		32	180.0	15		60	20	15	5		40	50	10	20 - 70	< 750	Some
		33 (24 and 26 incl in 25) (34 incl in 33)	120.0	10		5	30	25	40	neg	15	70	15	50 - 100	< 750	Most, (>20ft)
Southern India (S of 22°)	503	25	330.0	65	Triangular upland with raised rims, E and W coastal plain	64	35	1			65	20	15	50 - 60	2/3 > 750	1/2
		26	173.0	35		25	70	5	neg		70	25	5	50 - 60	1/2 > 750	1/2
Ceylon	25.3	27	25.3	100	Mtns S central, surrounded by hills and coastal plain	80	12	6	2		75	10	15	15 - 20	1/2 > 60	Mostly

*Below sea level

Confidential

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Climate Zone	Zone Area ($1000 mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cnure	
Burma	21 24 28 (29 incl in 28)	91.6 117.8 52.4	Monsoon drainage, 30 per cent rain June-Nov. Irrawaddy River access N-S, large delta area, 3 major river valleys	60 55 90	5[8] 30 8		35[7] 15 2			70 85 90	Mtns, forest Mtns, forest Mtns, forest	Canals in irrigation area 3-5 x 9, 3 x 10 lowland forests include bamboo to 40 ft
Northern India and Pakistan (incl Nepal and Bhutan)	25 28 29 31 32 33 (24 and 26 incl in 25) (34 incl in 33)	240.0 240.0 240.0 180.0 180.0 120.0	Monsoon drainage (June-Oct) by Ganges - central, Indus W, Brahmaputra E, zone 28, 1/2 zone 32 subject to floods, canals in these areas 5-12 x 100-300 and 1-5 x 50, steep banks to 20 ft, marsh on coast zones 25 and 31	25 15 20	10[30] 5 20 30 20 35		65[3] 75 10 10 5		5 desert 60 desert 60 desert 70 desert 60 desert (mostly bare)	15 60 100 5 35 40	Mtns, marsh Marsh, canals Mtns Swamp Mtns Mtns	All forests on steep slopes, no access across land borders, large dune and sand hill areas in zones 31 32, 33 to 100 ft, lee slopes t. 65 per cent
Southern India (S of 22°)	25 26	330.0 178.0	Western slope rivers all steep and rocky, coastal canal E	65 10	5 15		30[6] 75			15	Steep, forested	Ricefields have ditches 2 ft deep, continuous escarpment 30-50 miles inland from W coast
Ceylon	27	25.3	W coast waterway as narrow as 25 ft, numerous small reservoirs	75	10	5	10			25	Mtns, forest	Plantations coconut and rubber trees 15-20 ft, ricefields 2 ft embankments

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	>30%	freq. (mi.)	width (feet)	steep banks?
Afghanistan	251.0	29	25.1	10	65 per cent rugged highlands, lowlands in SW and N central, many glaciers in mtns E	neg	5	5	30	60	5	10	85	?	Wide channels	Most
		33	175.7	70			15	15	40	30	20	25	55	20 - 75		Most
		34	50.2	20			70	30			75	15	10	20 - 150		Most
Iran	636.3	32	31.8	5	Rugged mtn rim, extensive central lowlands, mostly dry except coastal plains on Caspian Sea and Persian Gulf	80	20				40	40	20	Coastal streams only		
		33	541.0	85		5	30	20	40	5	60	20	20	30 - 100	> 60	1/2
		34	63.6	10			60	25	15		40	10	20	Very few intermittent		
Arabian Peninsula (incl Aden, Yemen, Oman, Kuwait)	937.2	32	655.3	70	Large rolling desert, highlands W and S	55	40	5	neg		85	10	5	Very few perennial streams		
		33	281.9	30		5	30	40	25	neg	50	20	30	Numerous intermittent wadies		

*Below sea level

Confidential

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Climate Zone	Zone Area (1000 mi^2)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Afghanistan	29 33 34	25.1 175.7 50.2	Most streams dissipate in dry areas, rocky and steep banks in mtns, entrenched in lowlands	10	10[6] 60 15 (sparse)	10[3] 15	5 5		70 barren 20 barren 80 barren	95 70 10	Rugged Rugged Salt flats and marshes	Dune slopes to 100 per cent on lee side, dunes cover 10 per cent total area, cultivated stream valleys have numerous ditches and canals 6-7 x 10, many canals concrete and brick, zone 34 and S portion zone 33 subject to sandstorms from N and W winds, many open shafts to underground aqueducts ▲ 100-200 ft
Iran	32 33 34	31.8 541.0 63.6	Many intermittent streams and lakes, most streams dissipate in desert	5	15	90[2] 65 90	10		15 salt flats 10 salt flats	40 70 50	Mtns, loose sand Mtns, salt flats Mtns	Interior salt plains often have soft ground under crust, dune areas up to 4000 square mi lee slopes 60 per cent, underground water tunnels (qanats) in desert alluvial fans, vertical shafts▲ 50-600 ft, some dust storms in intermontane basins
Arabian Peninsula (incl Aden, Yemen, Oman, Kuwait)	32 33	655.3 281.0	Almost all streams intermittent, very meager water resources, mangrove swamps in Red Sea coastal area		2[15] 25		3 5 (cases)		95 desert 70 desert	15 70	Dissected plains, mtns, lava flows	Escarpments 4-800 mi long in dune ridge and western highlands, irrigation ditches and canals in oases, some pipelines above ground 3 ft, numerous steep sand dunes and soft sand, also salt basins

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	>30%	freq. (mi.)	width (feet)	steep banks?
Iraq, Syria, Jordan, Lebanon, Israel	292.1	32 33	58.4 233.3	20 80	Mediterranean plain, Jordan rift and mtns, sloping plateau and desert mtns, NE rugged	50 35 *3	50 50	neg 10	2		60 60	20 20	20 20	Very few Tigris-Euprates		Most
Turkey	303.1	33 40	287.9 15.2	95 5	2/3 mtns, 1/3 plateau and plains	10 70	40 30	25	22	3	30 65	35 30	35 5	40 ?	>50	3/4
Cyprus	3.6	33	3.6	100	Rugged island, E-W low-land belt	70	25	5	neg		40	40	20	Numerous	Small	Most
Malaya and Singapore	51.6	22	51.6	100	Mtn core with coastal plain	75	19	5	1		45	10	45	10 - 20	1/3>250	Most
Philippines	115.7	14	115.7	100	7000 islands, 460>1 sq. mi. hills and mtns 4/5	50	20	28	2		50	25	25	25 - 40 On large islands	<150	Most

*Below sea level

Confidential

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Climate Zone	Zone Area (1000 mi^2)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM s
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Iraq, Syria, Jordan, Lebanon, Israel	32 33	58.4 233.8	Tigris-Euphrates River; some canals in delta area, extensive levees on lower courses, large interior drainage area	5	5[3]	20	15		100 desert 55 desert	10 25	Mtns, dissected Mtns, plain	Escarpments and cliffs on zone border 32-33, also along Jordan rift from Lebanon to Aqaba, much of desert area is bare rock
Turkey	33 40	287.9 15.2		15 10	25[10] 30	15[2] 20	10[6] 40		5[2] semi desert	60 60	Mtns	
Cyprus	33	3.6	Irrigation ditches in central lowland	30	30		40			50	Mtns	Terraced hillsides and small irrigation works
Malaya and Singapore	22	51.0	Mtn streams swift, narrow, and rocky, mangrove swamps along coast with wide waterways	75	5[20]		10	10		80	Forest, mtns, swamp	Palm and rubber plantations, trees 50-75 ft high, 15-30 ft, ditches 2-3 x 3-4 between trees, levees on rivers in lowlands, drainage and irrigation ditches in western lowlands 7-9 x 30 with embankments, also 4 x 18 with 3 ft banks
Philippines	14	115.7	Tidal swamps near coast, 15 per cent Luzon subject to periodic flooding	60		10[5]	30			70	Mtns, forests swamps	Wetland rice paddies, dikes 1-2 x 1-2, 1.2 acre, min rice terraces with walls to 5 ft

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	>30%	freq. (mi.)	width (feet)	steep banks?
Indonesia																
British Borneo	76.5	18 19	30.6 45.9	40 60	2/3 mtns and hills with coastal plain	45 65	45 33	8 3	2 2	neg	5 30	35 30	60 40	20 - 30 60 - 80	2 - 3 < 250 < 250	Most Most
Sumatra	177.5	23	177.5	100	Mtns, forested plain, swamp forests	85	9	5	2	neg	70	20	10	20 - 30	> 80	Most except NE
Java, Bali, Madura	53.0	23	53.0	100	Intensively cultivated plains, some mtns	80	10	7	3	neg	60	32	8	30 - 60	> 80	Most
Indonesian Borneo	209.5 (19 incl in 19)	19	209.5	100	Rugged forests, swampy coast plain	85	10	4	1	neg	60	30	10	20 - 30	> 250	Most
Celebes, Moluccas, Sundras, Timor	135.0	19 23 (A)	108.0 27.0	80 20	Densely forested mtns	60 60	25 37	5 3	10 2	neg neg	30 30	30 65	20 5	20 - 60 Infrec.	80 - 150 < 80	Most Most
New Guinea	343.1	15 16 17	61.9 43.5 237.9	18 12 70	Densely forested rough mtns, with forested and swampy plains	10 100 80	10 15	10 15	40 15	25 5	5 100 15	30 25	65 60	Main streams 20 - 30 40 - 60	 > 250 < 80	 Few Most
S.W. Pacific	11.5	17	11.5	100	Steep hills dominate larger islands, many coral reefs	65	30	5	neg		20	35	45	Numerous small	< 80	Most

*Below sea level

Confidential

TABLE B-3 (Cont.)

Natural Environment of Asia (without USSR)

Data Division	Climate Zone	Zone Area ($1000 mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Cultivation	Marsh, Lake, Swamp	Other Vegetation	%unsuitable	Cause	
Indonesia												
British Borneo	18 19	30.6 45.9	Extensive mangrove and freshwater swamps near coast	90 60	10		20	20		100 90	Forests Forests, swamps	Coastal swamps impassable except by waterways
Sumatra	23	177.5	Extensive swamp forest NE	70		10	20			75	Forests, slopes, swamps	Only access to swamp areas by winding stream
Java, Bali, Madura	23	53.0	Artificial and natural levees on lower courses of rivers, many ditches	24		1	75			30	Slopes, soft ground	Rubber plantations, 30 ft high trees ▲15 ft, terraced rice fields and tea plantations, dense cultural features dikes 1-2 x 1-2 ▲100 ft
Indonesian Borneo	19 (18 incl in 19)	209.5	Extensive coastal swamps	85		5	10			95	Forests, slopes, swamps	
Celebes, Moluccas, Sundras, Timor	19 23 (A)	108.0 27.0		85 35		5 25	10 40			95 95	Forests, slopes, swamps	
New Guinea	15 16 17	61.9 43.5 237.8	Extensive coastal swamps, tidal flooding	70 50 85	10	20 45 10	5 5			100 50 90	Rugged Swamp Rugged, forest	Mangrove and nipa swamp forests near coasts plantation trees ▲25 ft
S.W. Pacific	17	11.5	Radial drainage in high islands, swift and rocky streams	60	10	10	20			80	Rugged, forests	

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

TABLE B-4

Natural Environment of Africa

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Egypt	386.1	4	386.1	100	Desert plateau with Nile Valley and delta escarpments almost continuous along Nile Valley	45 +3 *	40	2	neg		65	25	10	Nile Intermittent wadies	1000 + Wide	At edge of valley, flanked by canals and levels
Libya	679.4	4 (3 incl. in 4)	679.4	100	Desert plateau	50	47	2	1		60	25 including dissected plains	15	Infrequent wadies	?	Some
Tunisia,	1143.0	1	171.5	15	Costal mtn. range with	40	40	20			35	30	35	50 - 80	?	Most
Algeria,		2	228.7	20	intermingled plain,	30 +	30	35	4	1	45	35	20	Infrequent	?	Most
Morocco		4	742.8	65	large desert plateau	25 neg	55	15	5		60	25	15	Intermittent	?	Most
French West Africa*, Togo, Span. Sahara, Port. Guinea, Gambia	1973.0	4	1086.0	55	75 per cent upland plains,	83	15	2			85	10	5	Intermittent Wadies Only		
		5	395.0	20	dry north,	93	7	neg			90	7	3	Approx 150	> 250	Some
		7	493.0	25	wet south	75	23	2	neg		70	25	6	50 - 100	60 - 100	Mostly
Liberia, Sierra Leone	79.9	7	79.9	100	3/4 plain, 1/4 hills and mountains	65	35	neg			70	25	5	10 - 40	1/2 >60	Mostly
Ghana	91.8	7	91.8	100	90 per cent plains, rest hills, densely forested in south	90	10				80	20	neg	20 - 40	1/2 >60	Mostly

*Now Senegal, Mali, Mauritania, Guinea, Ivory Coast, Niger, Dahomey, Upper Volta

*Below sea level

Natural Environment of Africa

Confidential

Data Division	Climate Zone	Zone Area (1000 mi^2)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re CEM's
				Dense Forest	Brush Woods	Grass-lands	Cultivation	Marsh, Lake, Swamp	Other Vegetation	%unsuitable	Cause	
Egypt	4	386.1	Lower Nile controlled by dams and levees, with canals				3 grains & cotton		97% desert	12	mtns & slopes 2% marsh	Sand dunes steep on lee side Suez Canal, difficult x-c, Nile Valley canals, some low bridges, 6 ft deep, 8-65 ft wide, steep banks, others 365 feet wide with sloping embankments, 5-16 ft high, some above land level
Libya	4 (3 incl in 4)	679.4	No permanent streams, most wadies sloping banks, some steep				3[15] orchards grains & grass		60% bare desert 37% sparse desert	10	mtns and escarpments	Escarpments bordering parts of coastal plains and area SW and between dunes, dunes cover 15%, difficult to cross
Tunisia,	1	171.5	Seasonal high water, Nov-April, interior drainage region (80%) has intermittent streams mostly	15		45[6]	40			40	mtns	Olive orchards, 30 ft trees, 640 ft, leeward slopes of dunes 30-60%, some dunes to 800 ft high, dunes cover 20%
Algeria,	2	226.7				30	20		50% desert	30	mtns & boulder	
Morocco	4	742.8					1 date palms		99% desert	30	mtns & boulder	
French	4	1086.0	80% is desert drainage area, some coastal marshes in S.W.			5			95% desert	10	steep slopes	Natural stone dikes in some areas of Spanish Sahara, sand dunes, steep leeward slopes, some escarpments around hills in dry areas of zone 4 - 5
West	5	395.0			5	85[4]	5	5[8]		10	marshes & steep	
Africa*,	7	493.0		30	10	40	20			30	forests & steep	
Togo, Span Sahara, Port, Guinea, Gambia												
Liberia, Sierra Leone	7	70.9	Some mangrove coastal swamp, numerous lagoons	80	15[12]	5[5]			small mangrove swamps	70	forested plain, hills & mtns	
Ghana	7	91.8	Extensive marsh and swamp in coastal plains area	35		60[6]		5	scattered trees and brush in grasslands	35	forested dissected plain, wet constal areas, steep hills	Some escarpments

*Now Senegal, Mali, Mauritania, Guinea, Ivory Coast, Niger, Dahomey, Upper Volta

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-4 (Cont.)

Natural Environment of Africa

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	>30%	freq. (mi.)	width (feet)	steep banks?
Nigeria, British Cameroons	373.3	7	242.6	65	Flat to rolling plains,	45	50	5	neg		85	12	3	30 - 100	>250	Few
		8	130.7	35	hills and mtns eastern	55	35	7	3	neg	60	30	10	30 - 70	>250	1/2
French Equatorial Africa*, French Cameroun, Spanish Guinea	1146.7	4	137.7	12	Lowlands and plateaus	10	50	30	10	neg	60	25	15	Intermit-	Wide	Dry in season
		5	172.0	15		45	50	5			80	15	5	" tent	Wide	Dry in season
		6	286.7	25		15	70	15			80	15	5	20 - 50	?	Some
		8	459.6	40		15	60	20	5		60	30	10	20 - 50	?	Some
		11	91.7	8		40	60				50	35	15	20 - 50	?	Some
Republic of the Congo, (including Ruanda Urundi)	925.9	7	46.3	5	Large rolling plains, west	5	90	5			65	30	5	20 - 100	>250	1/2 East
		8	416.7	45	Hills and high mtns, east	30	65	5			85	15	neg	20 - 50	>500	Few
		9	46.3	5	boundary, 1/5 area wide		10	30	55	5	10	45	45	20 - 50	>250	Most
		11	416.7	45	rivers, extensive forests	15	50	30	5		65	30	5	20 - 80	>500	Few
Sudan	967.5	4	290.2	30	Northern sandy and rocky	28	70	2			70	20	10	Desert	Wadies	Some
		5	338.6	35	deserts, red soil hills and	10	80	10	neg		65	25	10	Nile	Wide	Some
		7	338.6	35	plains, southern highlands	5	90	5	neg		60	25	15	Scattered West	Prob wide	Few
Ethiopia, Eritrea, Somali Rep, French Somaliland	709.5	5	212.8	30	Low and high plains,	55	35	9	1		65	20	15	50 - 100	60 - 250	Mostly
		6	248.3	35	many deeply dissected,	2	15	25	50	8	55	25	20	30 - 100	60 - 500	Mostly
		11	248.3	35	scattered hills and mtns	50	35	15	neg		75	15	10	Appux 100	60 - 250	Mostly
Uganda	94.0	7	84.6	90	Central plains basin		10	82	7	1	85	12	3	30 - 50+	60 - 500	2/3
		9	9.4	10	fringed by highlands and		10	65	22	3	50	35	15	20 - 80	60 - 500	Most
					scattered high mtns											

*Now Central African Republic, Chad, Gabon, Congo

*Below sea level

Confidential

Confidential

TABLE B-4 (Cont.)

Natural Environment of Africa

Data Division	Climate Zone	Zone Area ($1000 mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution: Dense Forest	Brush Woods	Grasslands	Cultivation	Marsh, Lake, Swamp	Other Vegetation	Cross-Country Index*: Surmountable	Cross-Country Index*: Cause	Special Features re Cross-Country
Nigeria, British Cameroons	7	242.6	High water May - Sept marsh in Niger Delta and along much of coast	15	40^{10}	40^{4}	5			5	marshes, mtns	
	8	130.7		65	35					30	marshes, mtns	
French Equatorial Africa, French Cameroon, Spanish Guinea	4	137.7	Desert north to rain forest south, rapids on many rivers						100% desert	20	rough, dissected	
	5	172.0			10							
	7	261.7		10	40	50^{15}			90% desert	mostly ok		
	8	459.0		60	20^{10}	20^{15}				mostly ok		
	11	91.7		50	30	20				50	forest	
										40	forest	
Republic of the Congo, Ruanda-Urundi, Uganda	7	46.3	Large swamp area Congo & tributaries, 10% zone 8, 2% zone 11 Lake Tanganyika	10		90				10	rugged	Elephant grass to 15 feet, rough, also bamboo in some areas
	8	416.7		85		5^{15}		10^{15}	scattered trees in grasslands	90	forest, marsh	
	9	46.3		20	20	60				50	rugged	
	11	416.7		18	20	60		2^{15}	elephant grass in grasslands	20	rugged, forest	
Sudan	4	290.2	Nile drainage basin, several dams and rapids large swamp area in Sadd, always wet (40% of zone 7).		10^{5}							
	5	338.6			50^{4-6}	30^{6}			50% bare	Mostly ok except swamps, some steep banks of wadies, crossing Nile, and rough highlands		Scattered escarpments on Red Sea Hills and in desert areas, many scattered steep hills, vegetation more abundant along streams
	7	338.6		20	10^{15}	60 scattered trees		10^{20} floating reeds	40% sparse 20% sparse			
Ethiopia, Eritrea, Somali Rep, French Somaliland	5	212.8	Coastal stream valleys almost dry at low water Oct - April		10^{15}	10^{3}			80% semi desert	80	mtns & rough	Dune belts along 3/4 coasts, irrigation works along few rivers in zone 11, canals 2-3x15, some hill areas terraced, 5 ft earth walls
	9	248.3		20	20	15	30^{3}		15% " "	15	mtns & rough	
	11	248.3		5	20	20	5		50% " "	mostly ok		
Uganda	7	84.6	Large lake area Victoria et al (~17,000 miles), floating papyrus marshes 3 - 5 ft floating masses	15	20^{15}	55^{3}		10^{10}		30	marsh, forest	Tall grass, savannahs have scattered trees, some places close together, marsh areas have papyrus & rushes to 10 - 15 feet
	9	9.4		25	30	35		10		75	forested hills, steep	

* New Central African Republic, Chad, Gabon, Congo

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-4 (Cont.)

Natural Environment of Africa

Confidential

Data Division	Area (1000 mi^2)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi^2)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Kenya	223.5	10	44.7	20	Desert plain sloping up to rugged volcanic highlands in SW.			35	60	5	30	40	30	10 - 20	Prob. Narrow	Most
		11	178.8	80		30	25	30	15	neg	45	30	25	10 - 30	?	Some
Tanganyika (including Zanzibar)	363.7	10	18.2	5	Rough plateau with rugged mtns North.			50	50		60	30	10	Desert	East	
		11	345.5	95		10	20	55	15	neg	40	35	25	20 - 30	?	?
Mozambique	297.8	11	297.8	100	Wide coastal plain with hills south and west, mtns north.	60	25	12	3		50	30	20	20 - 40	?	Most
Federation of Rhodesia and Nyasaland	487.0	11	487.0	100	High plains, scattered hills and mtns.	3	30	60	7		70	25	5	15 - 100	High water>250 Low water 60 - 250	Few - West 1/2 East
Angola	481.4	11	361.0	75	Upland plain with hills and mtns dropping abruptly to narrow coastal plain.	10	20	50	20		55	30	15	20 - 60	?	Most
		12	120.4	25		25	20	40	15		40	35	25	20 - 60	?	Most
South Africa, SW Africa, Becnuana-land, Basu-toland, Swaziland	1083.2	11	216.5	20	High rough plateau with extremely rugged borders, very narrow coastal sand plains.	5	30	55	10		55	20	25	?	Probably wide exit in gorges	Most
		12	541.6	50		5	15	75	5		55	20	25	?		Most
		13	162.5	15		30	30	35	5		60	20	20	?		Most
		14	108.3	10		15	15	40	28	2	20	25	15	?		Most
		15	54.2	5		50	40	10			10	15	75	?		?
Madagas-car (Malagasy Republic)	230.2	16	103.6	45	Rough upland with steep eastern slopes, several scarp areas west	50	30	20	neg		20	30	50	20 - 50	?	Most
		17	96.8	42		40	30	20	10		20	30	50	20 - 40	?	Most
		18	20.9	13		60	30	10			40	25	35	40 - 60	?	Most

*Below sea level

Confidential

TABLE B-4 (Cont.)

Natural Environment of Africa

Confidential

Data Division	Climate Zone	Zone Area ($1000\ mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEMs
				Dense Forest	Brush Woods	Grass-lands	Cultivation	Marsh, Lake, Swamp	Other Vegetation	% unsuitable	Cause	
Kenya	10	44.7		25	5	70[3-5]			semi desert	60	rough & dense	
	11	178.8			5	65			25%	35	rough brush	
Tanganyika (including Zanzibar)	10	18.2		5	25	70				30	dense brush & rough	
	11	345.5		45	17	40	8			30	forested & rough	
Mozambique	11	297.8	Some swamps along coast	10	10[12]	80[3-5]				15	rough	
Federation of Rhodesia and Nyasaland	11	487.0	Numerous swamps in western basin 4% Victoria Falls, Lake Nyasa	65	10[13]+15[4]	6[2]		4[15]		20	soft ground & marshes, steep hills & mtns	Some intrenched streams in western basin, banks 15-20 feet, trees in forests separated 3 - 20 feet
Angola	11	361.0		65	30[12]	5[3-5]						
	13	120.4		40		45[3-5]			desert, semi desert 15[3] %	40	forested, rough	
										35	forested, steep	
South Africa, SW Africa, Bechuana-land, Basu-toland, Swaziland	11	216.5	Many rivers in deep gorges, falls at edge of central plateau	10	70	20				30	rough, & dissected plain	
	12	541.6			75	10[9]			15[2]			
	13	162.5							60 % sparse			
	14	198.3		10	30	60[4]			40% barren			
	15	54.2			40[8]							
Madagas-car (Malagasy Republic)	16	103.6	Canal along east coast with lagoons	20	40	35	5			50	rough	
	17	96.8		5	25	70				50	rough	
	18	29.9		5	70	25				30	rough	

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

TABLE B-5

Natural Environment of South America

Confidential

Data Division	Area (1000 mi^2)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi^2)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Brazil (NW)*	~2060	2	42.0	2	Vast Amazon forested plain, highlands SE	65	30	5			65	20	15	40-80	60-250	Most
		4	1030.0	50		05	5				05	5	neg	20-100	> 250	Most
		5	988.0	48		30	65	5	neg		80	15	5	40-60	60-500 +	Most
Brazil (SE)*	~1227	4	24.5	2	2/3 flat to rolling, hilic NE and E central, great escarpment SE const 850 miles from Sao Tomé to Porto Alegre	100					100			30-50	60-250	Some
		5	981.0	80		25	60	14	1		60	25	15	40-60	60-250	Some
		6	24.5	2		65	15				85	15		50-100	60-250	Most
		8	196.0	16		55	5	10			80	10	10	50-100	60-250	Most
		(7 and 8 incl. in 5)														
Uruguay	68.4	9	68.4	100	Rolling plains	05	5				55	35	10	~ 50	Unknown	< 1/2
Paraguay	157.0	5	86.3	55	Plains west, Plateau east	85	15				80	10	10	30-50	Unknown	1/2
		9	70.7	45		85	15				65	20	15	30-50	Unknown	1/2
		(16 incl. in 9)														
Argentina	1064.4	9	217.0	20	2/3 low and high rolling plain, 1/3 rugged Andes mtns	05	5				80	15	5	20-60	> 250	Few
		10	141.0	13		05	5	neg			90	5	5	40-70	60-250	Some
		11	378.2	35		48	40	10	2		65	20	15	> 100	60-250	Most
		12	108.4	10		20	40	35	5		20	50	30	20-100	< 60	Most
		13	21.7	2		50	45	5	neg		20	40	40	?	Narrow	Most
		23	217.0	20		--	10	25	30	35	5	20	75	Mtn St	reams	Most

*West of an arc extending from the Atlantic near Belem, through Brasilia, and the Paraná gorge to Paraguay

*Below sea level

Confidential

TABLE E-5 (Cont.)

Natural Environment of South America

Confidential

Data Division	Climate Zone	Zone Area (1000 mi²)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Brazil (NW) *	2	42.0	Wide, deep rivers in Amazon Basin, marshes in SW and Delta areas, also along major tributaries	75		25[6]		12		75	Forest and steep	Many rivers have rapids in middle and upper courses, and forested banks, high precipitation
	4	1030.0		90		5[5]		5		95	Forest and marsh	
	5	988.0		40		55[3]		5		55	Forest and marsh	
Brazil (SE)	4	24.5	Numerous marshes and lagoons on narrow coastal plain, steep banks in high plain W	40	40[20]		10[15]	10[20]		50	Forest	Some dunes N coast and far S, high humidity and precipitation
	5	981.0		10	60[20]	15[4]	15[3]			45	Rugged and forest	
	6	24.5			60[20]	20[4]	20[3]			--	Mostly O.K.	
	9	196.0		5	5	60	25	5		20	Forest and rough	
	(7 and 8 incl. in 5)											
Uruguay	9	68.4	Some marshes and lagoons on eastern coastal plain	10	3	80	7			10	Forest and rough	Many fences on ranches
Paraguay	5	86.3	Rio Paraná in deep gorge, Rio Paraguay extensive seasonal flooding	30	35	30	5			20	Forest and rough	
	9	70.7		45	30	15	10			30	Forest and rough	
	(10 incl. in 9)											
Argentina	9	217.0	Most stream valleys deeply incised in plateau area, large swamp areas in zones 9 and 10	10	20[30]	35[3]	20[3]	15[6]		25	Marsh and rugged	In NE numerous railroads fenced barbed wire to 5 feet
	10	141.0			35	40	25			10	Marsh	
	11	370.2		5	20	70	5			15	Rugged	
	12	108.4		5	5	90				20	Rugged	
	13	21.7		10	5	85				50	Rugged	
	23	217.0		15		80	5			75	Rugged	

*West of an arc extending from the Atlantic near Belém, through Brasília, and the Paraná gorge to Paraguay

*Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-5 (Cont'd.)

Natural Environment of South America

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet) *					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Chile	286.4	13	42.8	15	Coastal mtns and trough,	30	35	30	5		30	30	40	Fiords	Wide	Most
		14	42.8	15	with Andes ridge east	15	15	45	20	5	10	30	60	Fiords	Wide	Most
		15	42.8	15	frigid uplands at southern	60	20	20			30	30	40	30-50	Unknown	Some
		18	28.6	10	tip	15	40	40	5		30	30	40	Intermittent	Unknown	Most
		23	28.4	45		5	15	15	25	40	10	15	75	Small	Unknown	Most
		(6 incl. in 15)														
		(17 incl. in 18)														
Bolivia	424.2	4	50.9	12	Andes rugged chain and	65	30	5			70	20	10	20-40	Unknown	Some
		5	190.8	45	high plateau W, low plains	40	55	5			60	20	20	30-100	Unknown	Some
		23	182.5	43	east	5	5	10	30	50	15	20	65	50-100	Unknown	Most
Peru	496.2	4	193.4	40	Narrow coastal plain,	60	35	5			60	20	20	30-60	Unknown	Some
		18	24.8	5	Andes ridge, eastern	40	40	20			30	30	40	20-40	Unknown	Most
		19	24.8	5	forested lowland	55	30	15			50	30	20	20-40	Unknown	Most
		23	248.0	50		5	15	20	25	35	10	15	75	Numerous small	Unknown	Most
		(20 incl. in 19)														
Ecuador	102.4	4	35.8	35	Coastal plain,	55	40	5			80	10	10	?	?	?
		21	10.2	10	Andes chain,	60	40	neg			50	40	10	15-20	< 60	Most
		22	25.6	25	eastern rain forest	65	35	neg			70	20	10	15-20	60-120	Most
		23	30.7	30		5	15	20	35	25	10	20	70	Mtn. Streams		

*Below sea level

Confidential

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TABLE B-5 (Cont.)

Natural Environment of South America

Data Division	Climate Zone	Zone Area ($1000 mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Chile	13	42.8	Southern coast zones	60	20	20				60	Rugged and forest	GEM's confined to coastal area and interior trough
	14	42.8	13 and 14 cut by many	75	20		5			70	Rugged and forest	
	15	42.8	fiords, interior trough	20	25	15	40			40	Rugged and forest	
	18	28.6	irrigated		20	20			60 barren desert	40	Rugged	
	23	128.4		20	40	10			30 Alpine heath	90	Rugged	
	(16 incl. in 15)											
	(17 incl. in 18)											
Bolivia	4	50.9	Amazon drainage E,	70	30					70	Forest	High western plateau (12,000 ft); limited GEM ops, but no access
	5	190.8	very few drainage	25	60	15				30	Forest and rough	
	23	132.5	features in SE	15	20	20	5		40 Alpine heath	90	Steep and rough	
Peru	4	198.4	Western slopes dry	90	10					100	Forest	Coastal plain and hills, < 50 miles wide
	18	24.8	except at stream outlets,			10	5		85 barren desert	50	Rugged, dissected	
	19	24.8	which are oases			15	5		80 barren desert	30	Dissected plains	
	23	248.0		20	25	45			10 Alpine heath	95	Rugged, steep	
	(20 incl. in 19)											
Ecuador	4	35.8	Marshes on N portion	100						100	Forest	
	21	10.2	coast, eastern area	20	35	40	5			25	Forest and marsh	
	22	25.6	drains to Amazon	85	10		5			75	Forested	
	23	30.7		30	40	20			10 Alpine scrub	80	Rugged	

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-5 (Cont.)

Natural Environment of South America

Confidential

Data Division	Area (1000 mi^2)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi^2)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Colombia	439.5	2	131.8	30	Coastal and central forested lowlands divided by rugged Andes	80	15	3	2	1	80	10	10	10-60	>250	Most
		4	153.7	35		85	14	1	neg		90	5	5	20-50	>250	Most
		22	21.9	5		85	15	neg			80	10	10	~ 50	>150	Some
		23	131.8	30		5	20	30	30	15	10	15	75	Numerous small	--	Most
		(1 and 24 incl. in 2)														
Venezuela	352.1	3	340.0	88	2/3 plain, 1/3 hills and mtns N and SE	55	25	15	5	neg	40	45	15	25-150	>250	Some
		3	17.6	5		90	8	2			90	5	5	N.A. marshy area		-----
		4	24.6	7		35	60	5			90	5	5	40-150	>250	Some
Br. Guiana	173.2	2	86.7	50	Coastal plain, forested hills and low mtns inland	50	40	10			40	40	20	15-50	Unknown	Some
Dutch Guiana		3	34.7	20		95	5				80	20		15-50	Unknown	Some
Fr. Guiana		4	52.0	30		45	55				40	30	30	15-50	Unknown	Few

*Below sea level

Confidential

Natural Environment of South America

Confidential

Data Division	Climate Zone	Zone Area (1000 mi^2)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEN's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	% unsuit-able	Cause	
Colombia	2	131.8	Marshes along coast and in north central	30		65 1-5		5	Small semi-desert	30	Forest, wet, steep	Some irrigation canals in inland valleys
	4	153.7		95		5				100	Forest	
	22	21.9		85				15		95	Forest, wet	
	23	131.8		20	30 5-10	50				85	Steep	
	(1 and 24 incl. in 2)											
Venezuela	2	310.0	Extensive marsh area	55		40	1		4 desert	50	Forest	Stream beds in zone 4 have large rocks
	3	17.6	NE, and on Lake	5		5		90		90	Wet swamp	
	4	24.6	Maracaibo	100						100	Forest	
Br. Guiana	2	86.7	Lagoons near coast	60	10	30				70	Forest	Coastal plain irrigated for cultivation
Dutch Guiana	3	34.7		45	10	35	10			50	Forest and wet	
Fr. Guiana	4	52.0		100						100	Forest	

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

TABLE B-6

Natural Environment of North America

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	>30%	freq. (mi.)	width (feet)	steep banks?
Alaska	586.4	4	87.8 352.0	15 60	Interior plateaus, hills, and plains, surrounded by mtns N, E, S	65 65	30 20	5 10	neg 5		50 40	30 30	10 30	10 - 30 10 - 30	Braided Wide	Some Most
		5	87.9	15		20	30	30	18	2	10	20	30	Mtn streams -----		
		6	58.6	10		40	30	20	10	neg	10	20	70	Coastal fjords only		
Greenland	840.0	2	~135	16	High icecap inland (zone 3) surrounded by rugged coastal zone (2)	40	30	25 7	5 30	3	5 20	5 10	90	Fjords only -----		
		3	~705	84										Rocky streams on margins only		

*Below sea level

TABLE B-6 (Cont.)

Natural Environment of North America

Confidential

Data Division	Climate Zone	Zone Area ($1000\ mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Alaska	1	87.0	Numerous small lakes in flat areas, low steep banks 5-10 ft. Frozen - zone 1 Sept-June, zone 4 Oct-May, zone 6 Dec-May, fiords zone 6, Yukon and tributaries natural route.						100 tundra	20	Steep, streams	Zone 1 permanent permafrost all areas poor x-c conventional vehicles when thawed, steep banks 5 ft. common in North tundra, forests easily clearable by dozer except zone 6
	4	352.0		40	35				25 tundra	50	Steep	
	5	87.0		50	40				10 ice and snow	90	Steep	
	6	58.6		70	15				15 ice and snow	95	Steep	
Greenland	2	~135	Glaciers-20 mile intervals extend from icepack to fiords, summer lakes on icecap margin		scattered				30 barren	95	Icecap and rugged borders	Permafrost area and icings from: 64°N on west coast 68°N on east coast. Margins of icecap rough and crevassed, GEM could be used on icecap central area (90 per cent of icecap), but access very difficult
	3	~705			55	15			100 icecap	95		
					Vegetation snow-covered 8-10 months							

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

TABLE B-6 (Cont.)

Natural Environment of North America

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	>30%	Freq. (mi.)	Width (feet)	Steep banks?
Canada	3845.8	1	846.3	22	Rugged mtns west, rugged	89	8	3			25	40	35	Numerous small----		Most
		4	1920.0	50	hills E coast, vast central	55	35	8	2		55	25	20	[illegible] rivers, many lakes		
		5	307.9	8	plains and plateau area,	5	20	40	30	5	5	25	70	Hilly streams -------		
		6	38.5	1	tundra and polar climate	10	30	30	30		15	5	80	Flowing map -------		
		7	654.0	17	areas N, Hudson Bay	50	50				60	25	15	Many lakes, St. Lawrence River		
		10	75.1	2	lowland 33 per cent muskeg		60	35	5		75	17	15	-------		Most
U.S.A. (49 states)	3022.4	5	362.5	12	Atlantic and Gulf coastal	5	10	35	40	10	12	35	52	[illegible]		Most
		6	90.7	3	plains, separated from	40	25	20	15	neg	20	35	45	[illegible]	[illegible]	[illegible]
		7	272.0	9	central lowlands by	75	24	1			57	25	18	[illegible]	most <[illegible]	
		9	483.5	16	Appalachin mtns and hills,	80	18	2	neg		50	30	20	[illegible]	[illegible]	Some
		9	726.0	24	west rugged mtns sur-	85	15	neg			50	28	22	[illegible]	[illegible]	Some
		10	483.5	16	rounding rough plateau	neg	20	30	45	5	37	42	21	[illegible]		Most
		11	90.7	3	area, desert SW, Pacific	-----	neg	10	90		20	60	20	Very few		Most
		12	90.7	3	Coast rugged	70	25	5	neg		35	30	35	[illegible]	Some wide	Few
		14	241.8	8		10	25	35	30	neg	22	42	35	[illegible]	Wide ones	Most
		15	181.5	6		20	40	20	20		60	30	10	[illegible]		In west
		(13 incl in 14)														
		(22 incl in 9)														

*Below sea level

Confidential

TABLE B-6 (Cont.)

Natural Environment of North America

Confidential

Data Division	Climate Zone	Zone Area (1000 mi^2)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Canada	1	846.3	Large lake areas, surface waters frozen Dec-April in S, up to 9 months in N, connecting streams between lakes in Canadian Shield area are swift and rocky, (lakes >5 miles long <40 miles apart)	50	20 25			10 25	30 tundra	70	Rugged and frozen	Zone 1 ground permanently frozen, surface water in summer June-Sept., icings occur in permafrost areas, drumlins and eskers common in glacial shield; Yukon, Fraser, Columbia, Mackensie and Saskatchewan Rivers navigable parts of the year
	4	1923.0		50	20 25			10 25	10 ice and snow	60	Forested and wet	
	5	307.9		60	10		5		20 tundra	80	Rough and steep	
	6	38.5		60	20				25 tundra	90	Rough and steep	
	7	654.0		75	10	5	10		20 tundra	70	Forested	
	10	76.9		10	10	20	60 wheat			20	Rough	
U.S.A. (48 states)	5	362.5	Extensive inland waterways utilizing Missouri, Mississippi, Ohio, and tributaries, and most rivers in Atlantic Coastal Plain, also Great Lakes, Coastal swamps common in zone 9	45	5	15	20		15 desert brush	60	Rugged	Extensive built-up areas and dense transportation network all areas except zone 11 and 14 and west half zones 5 and 10, many fences and rail embarkments
	6	90.7		60	10		30			65	Rugged, forest	
	7	272.0		(30)			60	3	7 built-up	25	Rugged, built-up	
	8	483.5		(15)			77	neg	8 built-up	25	Rugged, built-up	
	9	726.0		(30)			57	10	3 built-up	20	Rugged, marsh	
	10	483.5		5	25	30	20		20 desert brush	25	Rugged	
	11	90.7		2	30		3		65 desert brush	20	Rugged	
	12	90.7		10	20	5	60		5 built-up	40	Rugged, built-up	
	14	241.8		10	20	20	5		45 desert brush	35	Rugged	
	15 (13 incl in 14) (22 incl in 9)	181.5		5	20	35	30 incl pasture		10 desert brush	15	Rugged	

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-6 (Cont.)

Natural Environment of North America

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Mexico	758.3	14	151.8	20	60 per cent hills and mtns	30	25	35	10		50	35	15	Very few	----------	
		15	189.6	25	with coastal lowlands ex-	30	20	20	30		40	30	30	50	60 - 250	Most
		16	189.6	25	tending full width at		10	25	60	5	30	40	30	Very few	--------	Most
		17	151.8	20	isthmus, two prominent	40	30	20	10		30	30	40	20 - 50	60 - 250	Most
		18	22.7	3	peninsulas	10	50	20	20		20	30	50	20 - 40	60 - 250	Most
		19	22.7	3		95	5	neg			80	15	5	20 - 40	> 250	Most
		20 (21 incl in 20)	30.3	4		100					95	5		none	----------	
Guatemala	42.0	17	8.4	20	Central mtns, large low-	50	20	20	10		50	30	20	10 - 30	60 - 250	Most
		18	16.8	40	lands N and on coasts	5	20	30	40	5	10	30	60	10 - 30	60 - 250	Most
		19	16.8	40		65	30	5			65	20	15	Very few	60 - 250	Some
Br. Honduras	8.9	19	8.9	100	Forested hills and plains	70	30	neg			60	20	20	10 - 30	?	Some
El Salvador	8.3	17	8.3	100	Hills and mountains, coastal plain	40	40	15	5		25	40	35	5 - 20	< 60	Most
Honduras	43.3	18	26.0	60	Central highlands, coast-	20	35	35	10		15	15	70	10 - 20	< 60	Most
		19	17.3	40	al lowlands	45	30	25	neg		40	30	30	10 - 30	< 60	Most

*Below sea level

Confidential

TABLE B-8 (Cont.)

Natural Environment of North America

Confidential

Data Division	Climate Zone	Zone Area ($1000 mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEMs
				Dense Forest	Brush Woods	Grass-lands	Cultivation	Marsh, Lake, Swamp	Other Vegetation	%unsuitable	Cause	
Mexico	14	151.8	Swamps common on coast of Yucatan Peninsula and isthmus, Colorado and Rio Grande rivers largely controlled		10[10]				90 semi-desert	30	Mtn, rough	Irrigated areas in Colorado delta, and on upper Rio Grande 2-5 x 3-10 ft, up to 5 ft deep 10-20 ft wide. Dust in dry areas, high humidity and precipitation SE, karst topography on Yucatan Peninsula
	15	189.6		25	60			5	10 semi-desert	40	Mtn, rough	
	16	189.6		40	55		5[8]			30	Mtn, rough	
	17	151.8		85			10		5 semi-desert	55	Mtn, forest	
	18	22.7		80			20			80	Mtn, forest	
	19	22.7		60				40		90	Swamp, forest	
	20 (21 incl in 20)	30.3		55			30[8]	15		15	Forest	
Guatemala	17	8.4	Swamp and lagoons along coast, karst drainage N third	65	20[10]	10[4]		5		40	Rough, wet	Small farms surrounded by hedges to 5 ft
	18	16.8		50	40	10				90	Steep, forest	
	19	16.8		80	15	5				70	Steep, forest	
British Honduras	19	8.9		90		5	5			65	Forest	
El Salvador	17	8.3	Swamp and marsh along coast	10	60[20]	5	20	5		70	Steep and rough	Coffee plantations to 10 ft included under "brush"
Honduras	18	26.0	Swamps on coasts extend 10-30 miles inland	60	10[10]		5[10]	5[20]		90	Steep, marsh	Access through swamps via rivers > 200 ft wide at coast, some ditches N plains 4 ft deep 6 ft wide spaced 400 yards
	19 (17 incl in 18)	17.3		70	15		5	10		70	Steep, marsh	

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

TABLE B-6 (Cont.)

Natural Environment of North America

Confidential

Data Division	Area (1000 mi²)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi²)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	>30%	freq. (rel.)	width (feet)	steep banks?
Nicaragua	57.1	17	17.1	30	Mtns N central, hills W and S	70	25	5			35	30	35	5 - 20	< 60	1/2
		18	14.3	25		30	40	30	neg		10	45	45	10 - 30	3/4 < 60	Most
		19	25.5	45		70	25	5			75	20	5	15 - 25	60 - 120	1/2
Costa Rica	19.7	17	11.8	60	Volcanic chains with central plateau	55	20	15	8	2	30	30	40	10 - 30	?	Most
		19	7.9	40		70	15	10	5		40	30	30	10 - 30	?	Most
Panama (incl Canal Zone)	29.1	17	17.5	60	Central mtns, lowlands N and S	75	15	10			25	40	35	5 - 20	< 60	All
		19	11.6	40		50	30	15	5	neg	20	40	40	5 - 20	< 60	All
Cuba	44.2	24	37.5	85	Rolling plain, steep N coast mtns E and NW	95	5	neg			60	25	15	Numerous small	60 - 120	Most
		25 (23 incl in 24)	6.7	15		70	25	5	neg		40	20	40		< 60	Most
Haiti - Dominican Republic	23.4	24	14.7	50	Rugged mtns, divided by valleys	50	20	25	5		20	20	60	Numerous small	< 60	Most
		25	7.4	25		50	20	25	5		20	20	60		< 60	Most
		26	7.3	25		65	30	5			30	20	50		< 60	Most
Jamaica	4.4	25	4.4	100	Mostly rugged, cultivated plains	45	40	13	2		20	30	50	Numerous	Small	Most
Puerto Rico	3.4	24 (26 incl in 24)	3.4	100	Rugged E-W mtns, N and S coastal plains	60	30	10			20	35	45	Numerous	Small	Most
-----	22	No Data	-----													

*Below sea level

Confidential

TABEL B-6 (Cont.)

Natural Environment of North America

Confidential

Data Division	Climate Zone	Zone Area (10^3 m.^{2})	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re CEMP's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Nicaragua	17 18 19	17.1 14.3 25.5	E coastal lagoons, lakes Nicaragua and Managua	20 60 65	30 30	20	5 10 5	25		50 70 95	Forest; lakes Forest, rugged Forest	
Costa Rica	17 19	11.8 7.9	Caribbean coast marshy	60 85	20	15	5 10	5		60 80	Rugged, forested	Banana plantations, dense trees
Panama (inc. Canal Zone)	17 19	17.5 11.6	Swamps on coast, particularly south	60 85	10 5	10^5	10^{10} 5	10^{tall} 5		85 95	Steep, dissected	Panama Canal 500 ft wide, locks 1000 ft wide
Cuba	24 25 (22 inc. in 24)	31.5 9.7	Marsh S central, many short N-S streams	20 40	15 20	20 20	40 20	5		25 50	Rough, marsh Mtn, rough	
Haiti-Dominican Republic	24 25 26	14.7 7.3 7.3	Some coastal marsh, some canals, irrigated areas	50 50 40	30 20 40		20 25 20	5		70 80 60	Mtn, rough Rugged, forest	Rough stoney ground and severely dissected plain, karst area S central and east Cuba
Jamaica	25	4.4		40	20	20	20			60	Rugged, forest	
Puerto Rico	24 (26 inc. in 24)	3.4	Swamps, N coast	30	10	20	40			55	Rugged, forest	
-----	22	No Data	-----									

* Suitability for movement of tracked vehicles, 12-15 psi ground pressure

Confidential

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TABLE B-7

Natural Environment of Australia, New Zealand, and Pacific Islands (Oceania) and Antarctica

Data Division	Area (1000 mi^2)	Climatic Correlation			General Terrain	Altitude Distribution (1000 feet)					Slope Distribution			Drainage-Stream Valleys		
		Climate Zone	Zone Area (1000 mi^2)	Per Cent		0-1	1-3	3-5	5-10	>10	0-10%	10-30%	> 30%	freq. (mi.)	width (feet)	steep banks?
Australia (Including Tasmania)	2974.6	1	148.7	5	Mostly arid plateau with central lowland and eastern rim highlands	60	40				50	40	0	20-50	Unknown	Few
		2	89.2	3		70	28	2			60	30	0	20-50	Unknown	Few
		3	1041.0	35		60	40				75	20	5	1/2, 30-100	Unknown	Few
		4	148.7	5		55	42	3			30	45	25	20-40	Unknown	Few
		5	89.2	3		30	50	18	2		10	40	50	20-40	Unknown	Few
		6	148.7	5		80	20				70	20	10	1/2, 30-100	Unknown	Few
		7	89.2	3		50	50				65	25	10	3/4, None	Unknown	Few
		8	1190.0	40		60	40				75	20	5	3/4, None	Unknown	Few
		9	14.9	0.5	Tasmania	30	50	20	neg		20	40	40	10-40	Unknown	Some
		10	14.9	0.5		40	50	10	neg		30	40	30	10-40	Unknown	Some
New Zealand	103.7	11	15.5	15	Rugged mtn backbone, with hills surrounding, few plains	40	35	20	5		5	15	80	5-20	50-250	Most
		12	82.9	80		50	20	25	5	neg	10	45	45	5-20	50-250 +	Most
		13	5.2	5		95	5				10	75	15	5-20	50-250	Some
S.W. Pacific Islands (Incl. Fijis, New Hebrides, New Caledonia, Gilbert's)	21.0	14-17	21.0	100	High and low islands	65	30	5	neg		30	35	35	Numerous small	< 60	Most
Hawaiian Islands	6.4	Climatic data not included	6.4	100	Volcanic Islands	40	30	15	15	neg	30	30	40	Numerous small	Unknown (Narrow?)	Most
Antarctica	~5500	1-9	~5500	100	Vast continental glacier with scattered coastal and inland mtns	(Approx. 40 per cent) Unreliable			~40	~20	~70 Unreliable	~20	~10	Very Few	-----	-----

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TABLE B-7 (Cont.)

Natural Environment of Australia, New Zealand, and Pacific Islands (Oceania) and Antarctica

Data Division	Climate Zone	Zone Area ($1000 mi^2$)	Special Drainage Features	Vegetation and Surface Cover Distribution						Cross-Country Index *		Special Features re GEM's
				Dense Forest	Brush Woods	Grass-lands	Culti-vation	Marsh, Lake, Swamp	Other Vegetation	%unsuit-able	Cause	
Australia (Including Tasmania)	1	148.7	Large unco-ordinated drainage area in western plateau and desert, streams mostly intermittent except in zones 4, 5, 9, and 10	30	55	10		5		10	Rough	Forests mostly open except in zones 4, 5, 7, and 9 sand dune area 50 per cent of zone 8
	2	89.2		40	40	20				10	Rough	
	3	1041.0		5	30	65				10	Rough	
	4	148.7		28	50	20	2			40	Forested and rough	
	5	89.2		40	30	14	15		1 per cent barren	40	Forested and rough	
	6	146.7		5	35	35	25			10	Rough	
	7	89.2		20	25	35	20			10	Rough	
	8	1190.0			10	30			60 per cent desert	10	Rough	
	9	14.9		60	20	15			5 per cent barren	60	Forested hills	
	10	14.9		70	20		5		5 per cent barren	60	Forested hills	
New Zealand	11	15.5	Numerous small streams on volcanic slopes, fiords west coast South Island	75	10	10			5 per cent bare and glacier	80	Mtns and forested hills	
	12	82.9		35	8	45	10		2 per cent bare and glacier	65	Mtns and forested hills	
	13	5.2		40	10	45			5 per cent dunes	30	Mtns and forested hills	
S.W. Pacific Islands (Incl. Fiji, New Hebrides, New Caledonia, Gilbert's)	14-17	21.0	Low islands have few permanent streams, radial drainage in high islands	60	10	10	20			80	Rugged and forest	Streams rocky, not suitable for GEM's
Hawaiian Islands	Climatic data not included	6.4	Irrigated lowlands for agriculture	25		50	9 Sugar and pineapple		16 per cent barren and waste-land	60	Steep, and dissected hills	
Antarctica	1-9	~ 5500	Glacial drainage	None	----	----	----	----	98 per cent ice 2 per cent rock	* Suitability for movement of tracked vehicles, 12-15 psi ground pressure Limited capability on ice-cap and ice shelves for special vehicles only		Snow dunes on icecap, 40-50 feet deep, sastrugi to 5 feet high, pressure ridges around exposed rock areas, crevasses up to several hundred feet wide, mostly at edge of continental glacier

APPENDIX C

NATURAL ENVIRONMENT OF COASTAL AREAS

APPENDIX C

NATURAL ENVIRONMENT OF COASTAL AREAS

This appendix contains the background data for amphibious operations of Ground Effect Machines. These data represent the primary geographical parameters of the coastal regions of the world, with particular emphasis on the elements affecting GEMs.

In one important respect Appendix C differs from Appendices A and B, covering climatic, oceanographic, and continental environment data--the data used are much more of a qualitative nature. Quantitative geographic data on coastal areas have heretofore been restricted almost entirely to those data needed for planning conventional amphibious operations. Where these studies have not been made, coastal data are limited to generalized landform and vegetation distributions, and brief data on coastal stream valleys.

Every effort has been made to provide complete data coverage for all the elements of this appendix, but in some categories, especially the characteristics of beaches, full coverage would necessitate extensive field survey. Accordingly, the data forms are filled in to the greatest extent

available from all the data sources used, and missing data are indicated by a question mark or the word "unknown." The qualitative evaluation of suitability for GEM amphibious operations included at the bottom of the data sheets represents an appraisal of the data available for the area, including all background material elements. This appraisal has also been portrayed in Figure 14 of the report (Volume I).

Data sources used for assembling the data of this appendix are the same as those used for Appendix B. Characteristics of beaches and landing areas are given in Section 22 of the appropriate National Intelligence Survey series.

The following notes will assist in understanding the form of data presentation:

(1) The data are tabulated in terms of coasts of continents fronting on the oceans and major seas. The world's mainland coasts and major islands are included in these data, with the exception of the North American Arctic Islands above 77° latitude. The breakdown by continents and oceans is on the basis of convenience and continuity rather than the strictest geographic identity; for example, the Black Sea coasts of Romania and Bulgaria are grouped with those of the U.S.S.R. and Turkey and the Mediterranean Coasts of Western Asia.

Each data column represents the coastal area of a political unit or other convenient geographic unit within the data group. For a few political units with extensive coastlines on a given ocean, e.g., the Arctic Coast of the U.S.S.R., varying characteristics within the entire area are indicated by a breakdown into two or more columns.

(2) The coastal climate zones taken from Figures 1 to 7 in Chapter I (Volume I) represent the Bailey classification referred to in Section 2 and are included for better correlation of these data with those of Appendices A and B.

(3) The total coast length includes offshore islands. The mainland coast length, where available, includes major gulfs and bays, but not the minor indentations. These numbers, and the others listed in this appendix, are given in statute miles.

(4) The coastal terrain represents a brief description of the coastal landforms, and the terrain backing most of the beaches along the coast.

(5) The data on coastal stream valleys are similar to those included in Appendix B, except that the qualitative notation of steep banks has been broken down into the near coast and inland areas, divided at about 15 to 20 miles from the coast. Again, the definition of steep banks is not rigorous, but generally includes banks over 10 feet and near vertical, or over 15 feet with slopes of 50 to 100 per cent or greater.

(6) The characteristics of beaches, where these data are available, include number of beaches, percentage over two miles long, percentage with widths over 50 feet and over 100 feet at high water, the maximum gradient in the high water zone (the portion of the beach above normal high tide) the most common beach materials, and approach obstructions, if any.

(7) Maximum surf heights and tidal ranges are given in feet. Storm conditions are not included.

(8) Coastal vegetation includes the vegetation near the coast or backing the beaches if applicable.

(9) The special features of coastal areas include notation of ice-bound coasts and other particular features.

(10) The GEM feasibility evaluation represents a qualitative appraisal of suitability for GEM coastal operations. (See also Figure 14 (Chapter I), Volume I.) The percentages

given represent the percentages of mainland coast length if it is given. The following definition of the zone breakdown has been used:

Zone 1. Coasts suitable for GEM access inland over the beach, or through stream valleys.

Zone 2. Coasts suitable for GEM landings on beaches, but not providing easy GEM access inland.

Zone 3. Coasts which are unsuitable for GEM amphibious operations.

(11) A word of caution is again appropriate. The data represent area coverage rather than point locations. Any individual location may have characteristics differing from those of the general area. Therefore these data do not represent sufficient source material to support or reject a specific operation at any particular point.

TABLE C-1

Atlantic Coasts of Europe

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Country Coastal Climate Zones	Spain (part), 45, 47A, 48A, 48B	France (part) 48B	Belgium Netherlands 48B	Germany (part) 48B	Denmark (part) 48B	Norway 51A, 52, 53, 54A
Total Coast Length (mi) Mainland Coast Length (mi) Coastal Terrain	1505 1505 dunes & banks, or cliffs	1330 1330 low cliffs, sea-walls	840 640 steep dunes to 100 ft., seawalls & dikes	450 270 mud flats & dunes, dikes	230 230 grassy dunes	3370 2370 rocky & forested hills
Coastal Stream Valleys - freq.(mi)	15-75	100	10-15	20	5-15	10-30
--water width (ft) --length (at above width) (mi) --steep banks near coast <15-20 mi --steep banks inland >15-20 mi	50-500 mostly ~ 50 1/3 2/3	1/2 > 250 for 5 mi. 20-600 few few	60-250 interconnected diked 15-20 ft. diked 3-6 ft.	> 175 interconnected few few	< 60 15 few few	fiords ▲ 25 mi. wide (> 600 ft.) 75 most most
Characteristics of beaches - no. --length, % > 2 mi. --width, % > 50 ft. at H.W. --width, % > 100 ft. at H.W. --max. slope, H.W. zone (%) --material --approach obstructions	213 25 95 85 6-15 sand scattered exposed & submerged rock	240 avg. 2.2 mi. 80 40 6-20 sand (?)soft when dry bars & mud flats at low tide	29 avg. 6 mi. 85 70 6-10 sand wrecks & shoals in parts	12 80 100 100 3-7 sand sand & mud flats	9 all (avg. 15) 100 100 3-6 sand scattered bars	75 none 75 30 3-10 sand, some boulders channeled by small islands
Surf - max. height (ft.) Tidal Range (ft.) Coastal Vegetation	8-12 9-13 cultivation & brush	5-12+ 11-40 cultivation	30% > 4 5-17 cultivation, irrigation features	5-8 6-13	3-8 1-6 cultivation	3-8+ neg - 8 forest, some cultivation & grass
Special Features of Coastal Area	breakers 4 mi. out in N portion	seawalls 3-20 ft.	10% breakers > 8 ft., steep ramp	20% breakers dil	many coastal streams canalized to 30 ft. width	indentations > fiords not incl in coast length, many small islands, fog common, some ice
GEM Feasibility - see Figure 14 --% Zone 1 --% Zone 2 --% Zone 3	45 35 20	55 45 -	100 - -	100 - -	100 - -	- 75 25

TABLE C-1 (Cont.)

Atlantic Coasts of Europe

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Country Coastal Climate Zones	United Kingdom incl channel Isl. 49	United Kingdom Outlying Islands* 49	Norway 48		Iceland 55, 56A	Spain -
Total Coast Length (mi)	5700	1500	320		100	300
Mainland Coast Length (mi)	5580	N.A.	320		100	N.A.
Coastal Terrain	mostly rocky, except beaches & stream valleys	rocky, with cliffs, dunes behind beaches	mostly rocky		steep slopes, lava strewn plain, many fiords	wooded slopes
Coastal Stream Valleys - freq.(mi)	10-30	unknown	10-30		6-20	unknown
--water width (ft)	mostly > 250		mostly > 250		mostly 20-40	
--length (at above width) (mi)	?		?		mostly 30-70	
--steep banks near coast <15-20 mi	few		?		few	
--steep banks inland>15-20 mi	?		?		most	
Characteristics of beaches - no.	331	123	25		54	23
--length, % > 2 mi.	30	15	20		10	none
--width, % > 50 ft. at H.W.	~ 70	55	60		65	65
--width, %> 100 ft. at H.W.	~ 50	30	15		30	30
--max. slope, H.W. zone (%)	3-10	3-10	6-10		20	6-20
--material	sand, gravel, cobble	sand	sand		sand, cobble	sand, pebbles
--approach obstructions	scattered rocks & shoals	1/2 partly obstructed by rocks & shoals	scattered rocks in 1/3 area		none	none
Surf - max. height (ft.)	to 45%>4ft. winter	to 47%>4 ft. winter	19%> 4 ft. winter		8-12	5-12
Tidal Range (ft.)	6-40	3-13	3-13		8-14	8-5
Coastal Vegetation	grass & cultivation	grass, cultivation	grass, cultivation		grass (?)	sparse
Special Features of Coastal Area	seawalls back many beaches	* Shetlands, Orkneys, Hebrides			climate mild for latitude	
GEM Feasibility - see Figure 14						
--% Zone 1	55	Not Tabulated	100	0	0	Not Tabulated
--% Zone 2	45		-	0	0	
--% Zone 3	-		-		0	

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TABLE C-2

Baltic Coasts of Europe

CONFIDENTIAL

Country Coastal Climate Zones	Denmark (part) 48B	Germany (part) 48B	Poland 50A	USSR (part) 2D, 50A	Finland 2D	Sweden 2D, 51A
Total Coast Length (mi)	1360	665	266	1480	1325	1895
Mainland Coast Length (mi)	360	265	266	940	1125	1430
Coastal Terrain	low cliffs & low flat shores	steep banks & wooded dunes	sandy dunes & low hills	sand dunes, swamps & marshes	low cliffs, rock & gravel, backed by plains	rocky forested coast, with fiords & many islands
Coastal Stream Valleys - freq.(mi)	5-15	20	25	40-200	20	10-50
--water width (ft)	< 60	> 175	up to 1000	> 500	> 50	?
--length (at above width) (mi)	15-30	interconnected	X-C	> 300	< 120	up to 40
--steep banks near coast <15-20 mi	few	few	none	none	few	most
--steep banks inland >15-20 mi	few	few	few	few	few	most
Characteristics of beaches - no.	45	40	27	68	24	26
--length, % > 2 mi.	85	60	90	45	20	65
--width, % > 50 ft. at H.W.	35	100	100	100	85	100
--width, % > 100 ft. at H.W.	none	20	60	60	65	50
--max. slope, H.W. zone (%)	3-10	2-6	3-6	3-6	2-6	1-8
--material	sand, pebble	sand, cobbles, pebbles	sand	sand	sand	sand
--approach obstructions	none	shoals	none	scattered rocks & shoals	none	mostly clear
Surf - max. height (ft.)	3-8	3-8	3-8	3-6	3-6	3-8
Tidal Range (ft.)	neg	neg	neg	neg	neg	neg
Coastal Vegetation	cultivation	cultivated & marshes	wooded, some cultivation	sparse woods & grasses	scattered trees, grass	grass, woods
Special Features of Coastal Area	irrigation ditches common, coastal streams often canalized to 30 ft. wide	10% breakers > 4 ft. winter, fog common winter	wind changes water levels up to 6 ft.	frozen 3 months ice hummocks, fog common	wind changes water levels, frozen Dec. -May N, Jan. -Apr. S	wind-caused water changes to 6 ft., frozen 3 months N
GEM Feasibility - see Figure 14						
--% Zone 1	100	100	100	100	100	55
--% Zone 2	-	-	-	-	-	45
--% Zone 3	-	-	-	-	-	-

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TABLE C-3

Arctic Coasts of Europe - Asia

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Country Coastal Climate Zones	Svalbards & Jan Mayen Isl. 1	USSR (part) Northern Europe Area 1, 2E, 2F	USSR (part) Arctic Islands* 1	USSR (part) Siberian Arctic 1, 2A		
Total Coast Length (mi)	1500	3460	2050	14,300		
Mainland Coast Length (mi)	N. A.	3460	N. A.	12,000		
Coastal Terrain	steep banked fiords with glaciers & ice cliffs	moss-covered hills & tundra	barren terrain low cliffs	hilly tundra some steep cliffs		
Coastal Stream Valleys - freq.(mi)	unknown	40-100	unknown	40-100		
--water width (ft)	↓	> 250	↓	> 250		
--length (at above width) (mi)		100-300		100-500		
--steep banks near coast <15-20 mi		none		few		
--steep banks inland >15-20 mi		few		few		
Characteristics of beaches - no.	11	80	22	116		
--length, % > 2 mi.	50	60	none	75		
--width, % > 50 ft. at H. W.	50	50	40	90		
--width, % > 100 ft. at H. W.	none	10	none	55		
--max. slope, H. W. zone (%)	6-20	6-20	6-20	2-6		
--material	sand, driftwood	sand, pebbles	sand, pebbles, cobble	sand, pebbles		
--approach obstructions	sea ice	shoals & banks	frozen 10-12 months	shoals, scattered rocks		
Surf - max. height (ft.)	5-12	3-8	?	2-8		
Tidal Range (ft.)	3-5	1-8	1-2	1-8		
Coastal Vegetation	none	tundra	moss & lichens	grass & moss		
Special Features of Coastal Area	edge of polar ice pack, fog summer		*Novaya Zemlya, Franz Josef Land	frozen Oct-July		
GEM Feasibility - see Figure 14						
--% Zone 1	-	100	-	85		
--% Zone 2	-	-	50	10		
--% Zone 3	100	-	50	5		

TABLE C-4

Pacific Coasts of Asia

CONFIDENTIAL

Country	U.S.S.R. (part)	Korea	Japan	China (mainland)	China (Taiwan)	China (Hainan)
Coastal Climate Zones	2B, 2C, 3, 4, 5A	6A	9, 10, 11	6A, 7A, 8A, 12A	12A	13
Total Coast Length (mi)	9300	2300	~10,000	5170	587	556
Mainland Coast Length (mi)	9300	2300.	9480	5170	NA	NA
Coastal Terrain	rugged cliffs with rolling hills flanked by Mtns.	narrow coastal lowland alternate with cliffs & rocky uplands	Mtns. rise from cliffs	bluffs, hilly except for river valleys	sand hills & steep grassy hills	hills & Mtns. except on N shore
Coastal Stream Valleys - freq.(mi)	60-200	10-60	15-100	30-100	?	?
--water width (ft)	>250 ?	>40	>100	>150, many >250	?	?
--length (at above width) (mi)	40-100	<75	>500	>100	steep & fast	<60
--steep banks near coast <15-20 mi	few	1/2	levees	few	most	few
--steep banks inland>15-20 mi	?	most	most	few, some dikes	most	most
Characteristics of beaches - no.	187	481	659	345	67	26
--length, % > 2 mi.	55	55	35	55	40	60
--width, % > 50 ft. at H. W.	100	50	45	95	70	?
--width, %> 100 ft. at H. W.	20	none	10	50	40	?
--max. slope, H. W. zone (%)	2-6	3-10	3-20	3-10	1-10	2-10
--material	sand, pebbles	sand, muc	sand, mud, gravel	sand, mud, pebbles	sand mud, rocks	sand
--approach obstructions	scattered shoals & rocks	scattered rocks, reefs, islets	reefs, shoals, bars	mudflats, shoals reefs	reefs & shoals	bars, rocks shoals & wrecks
Surf - max. height (ft.)	2-8	1-8	2-12+	2-12	5-12	3-5
Tidal Range (ft.)	neg - 24	1	1-16	3-24	2-9	3-11
Coastal Vegetation	grass & scrub trees	cultivation, sparse trees	cultivation, trees, irrigation features	cultivation, mostly irrigated	cultivation	cultivation, scattered trees
Special Features of Coastal Area	numerous fringing islands	coastal plain intensely cultivated	coastal plain densely settled & intensively cultivated	numerous villages in all plains area	--	--
GEM Feasibility - see Figure 14						
--% Zone 1	5	--	--	40	--	Not Tabulated
--% Zone 2	95	40	80	60	100	
--% Zone 3	--	60	20	--	--	

TABLE C-5

Southwest Pacific Coasts of Asia

CONFIDENTIAL

Country	Indochina *	Thailand	Malaya	Indonesia (major Islands) *	New Guinea (E & W)	Philippines
Coastal Climate Zones	12A, 20, 21A 21B, 21C, 21D, 21E	21E, 22	22	19, 23	16, 17	14
Total Coast Length (mi)	1700	1370	1250	13,365	7915	14,000
Mainland Coast Length (mi)	1700	1370	1250	N.A.	N.A.	N.A.
Coastal Terrain	featureless deltas & swamps, some Mtns. in N	narrow plain interrupted by hills and ridges	jungle plains, Mtns. rise near coast	forested & swampy plain	swamps & forested hills	forested plains, interrupted by Mtns
Coastal Stream Valleys - freq.(mi)	15-50	20-50	10-20	40-1	20-100	30-80
--water width (ft)	2/3 >250	?	>250	>500	>250	1/2 >150
--length (at above width) (mi)	50-300	100-300	30-100	60-200	30-100	<50
--steep banks near coast <15-20 mi	few	few	few	few	few	few
--steep banks inland >15-20 mi	?	few	few	most	most	few
Characteristics of beaches - no.	119	114	110	665	235	328
--length, % > 2 mi.	70	50	50	30	~60	30
--width, % > 50 ft. at H.W.	70	50	50	50	50	50
--width, % > 100 ft. at H.W.	40	none	none	15	none	none
--max. slope, H.W. zone (%)	3-10	3-10	3-10	3-10	2-10	3-10
--material	sand, mud, pebbles	sand, mud	sand, mud	sand, mud	sand, mud	sand, pebbles
--approach obstructions	sand & mud flats	sand bars & islands	mud flats	coral reefs, shoals	coral reefs, scattered rocks	scattered reefs, rocks, shoals
Surf - max. height (ft.)	2-12	3-8	3-8	3-8+	3-8	3-5
Tidal Range (ft.)	1-11	2-11	4-12	1-11	2-16	3-6
Coastal Vegetation	mangrove & forests	mangrove, forest, grass, cultivation	mangrove, forest	mangrove, forests, tree plantations	swamp forests	forests, mangrove
Special Features of Coastal Area	*Viet Nam, Cambodia	--	--	*Sumatra, Borneo, Celebes	coral pinnacles on & off shore	movement difficult because of vegetation
GEM Feasibility - see Figure 14						
--% Zone 1	10	50	--	25	15	--
--% Zone 2	90	20	100	25	10	50
--% Zone 3	--	30	--	50	75	50

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TABLE C-6

Indian and Arabian Coasts of Asia

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Country Coastal Climate Zones	Burma 24A	India Pakistan 24A, 25A, 25B, 25C, 25D, 31A, 32A	Ceylon 27	Iran, Iraq 32A	Arabian Peninsula (E)* 32A, 32B, 32C	Arabian Peninsula (S, W)* 32D
Total Coast Length (mi)	1200	4330	840	1620	1500	3000
Mainland Coast Length (mi)	1200	4330	N.A.	1520	1500	3000
Coastal Terrain	swamps & forested hills	coastal flats & undulating plain	coastal plain backed by mtns.	dunes & sand hills, backed by mtns in E	stoney desert, scattered coastal swamp	narrow coastal plain backed by mtns.
Coastal Stream Valleys - freq.(mi)	20-40	30-100	15-30	15-80	numerous intermittent	numerous intermittent
--water width (ft)	> 175	most > 750	> 250	> 100	probably wide	probably wide
--length (at above width) (mi)	? (mostly short)	100-400	50-80	100-200	?	?
--steep banks near coast <15-20 mi	few	few	few	few	few	few
--steep banks inland>15-20 mi	most	few	few	?	some intrenched	some intrenched
Characteristics of beaches - no.	147	239	60	114	54	36
--length, % > 2 mi.	20	80	80	60	50	60
--width, % > 50 ft. at H.W.	70	90	70	50	40	100
--width, % > 100 ft. at H.W.	30	30	30	none	none	70
--max. slope, H.W. zone (%)	1-10	2-10	2-10	2-10	1-10	1-3
--material	sand, mud	sand	sand	sand, shell, mud	sand, mud, shell	sand, shell
--approach obstructions	mud flats & shoals	scattered shoals & rocks	shoals & rocks	shoals, some coral	scattered shoals & rocks	mostly clear
Surf - max. height (ft.)	3-12	3-8+	2-8	3-8	2-8	2-8
Tidal Range (ft.)	11-19	2-12	2	2-8	4-8	4-7
Coastal Vegetation	mangrove, forests	forests, cultivation	forests	cultivation, some mangrove	sparse	sparse brush, scattered mangrove swamp
Special Features of Coastal Area	many fringing islands	densely settled along coasts except in swampy deltas	lagoon & marsh belt between beaches & mtns.	intermittent sea cliffs in W	*Persian Gulf, Gulf of Oman	*Arabian Sea, Red Sea
GEM Feasibility - see Figure 14						
--% Zone 1	-	50	20	10	60	-
--% Zone 2	10	20	35	40	-	30
--% Zone 3	90	30	45	50	40	70

TABLE C-7

Eastern Mediterranean and Black Sea Coasts of Europe - Asia

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Country Coastal Climate Zones	Israel, Lebanon Syria 33A	Turkey (part) Mediterranean Coast 33A	Turkey (part) Black Sea Coast 33, 37, 38, 40	USSR (part) Black Sea Coast 7B, 7C, 36, 42A	Romania Bulgaria 39, 42A	Cyprus 33A
Total Coast Length (mi)	389	1885	1525	2230	307	403
Mainland Coast Length (mi)	389	1885	1525	2230	307	N.A.
Coastal Terrain	scarps, cliffs, bluffs, backed by steep slopes	rugged hills & mtns, many bays	cliffs & hills	cliffy headlands backed by treeless steppe, mts. E	bluffs & cliffs S, marsh N	terraces, narrow plain, backed by mtns
Coastal Stream Valleys - freq.(mi)	?	20-50	20-50	40-100	25-100	3-20
--water width (ft)	?	> 100	> 100	> 250	> 100	?
--length (at above width) (mi)	short, steep	50-300	50-300	> 100	< 60	< 25
--steep banks near coast <15-20 mi	most	1/2	1/2	none	few	most
--steep banks inland>15-20 mi	most	3/4	3/4	few	few	most
Characteristics of beaches - no.	74	186	133	185	78	76
--length, % > 2 mi.	45	45	50	40	25	35
--width, % > 50 ft. at H.W.	70	55	50	85	70	100
--width, %> 100 ft. at H.W.	45	10	none	5	35	?
--max. slope, H.W. zone (%)	3-10	3-10	3-10	3-15	3-20	3-20
--material	sand, gravel, cobble	sand, pebble	sand, pebble	sand	sand, pebble, silt	sand, gravel
--approach obstructions	scattered reefs, rocks, islets	none	scattered rocks & shoals	scattered rocks & shoals	scattered bars	rocky boulders
Surf - max. height (ft.)	2-8	5-8	5-8	5-8	5-6	8-12
Tidal Range (ft.)	1-2	neg	neg	neg	neg	1
Coastal Vegetation	cultivation	sparse brush	cultivation, brush	cultivation, marshes	cultivation	some cultivation
Special Features of Coastal Area			includes straits area	ice in winter 1-5 months	occasional ice	
GEM Feasibility - see Figure 14						
--% Zone 1	-	20	20	75	75	-
--% Zone 2	100	80	80	25	25	100
--% Zone 3	-	-	-	-	-	-

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TABLE C-8.

Mediterranean Coasts of Europe

CONFIDENTIAL

Country	Spain (part)	France (part)	Italy	Yugoslavia, Albania	Greece	Major Islands*
Coastal Climate Zones	45	45	42B, 43A, 45	41A, 42B	41A	41A, 43A
Total Coast Length (mi)	1325	800	3250	2165	4410	230 (incl. by
Mainland Coast Length (mi)	845	400	2025	1165	2600	N.A. country)
Coastal Terrain	rugged hills	low bluffs & dunes	narrow coastal plain	mostly rocky cliffs	mtns. with scattered coast plain	bluff & dune, narrow plain scattered
Coastal Stream Valleys - freq.(mi)	15-75	10-60	Po Valley 10-20 / Peninsula 20-100	none in karst area, a few in Albania	30-60	20-100
--water width (ft)	mostly < 50	1/2 > 250 for 5 mi.	> 500 / 60-100		25-175	60-250
--length (at above width) (mi)	50	20-200	100-300 / 30-70		30-75	<50, into mtns.
--steep banks near coast <15-20 mi	1/3	few	levees / ?	most	1	few
--steep banks inland>15-20 mi	2/3	?	few / most	all	all	most
Characteristics of beaches - no.	80	89	334	114	2[illegible]	502
--length, % > 2 mi.	60	60	avg. 4 mi.	very few	avg. 5 mi.	avg. 2 mi.
--width, % > 50 ft. at H.W.	100	90	100	70	65	85
--width, % > 100 ft. at H.W.	70	20	50	30	35	20
--max. slope, H.W. zone (%)	6-20	6-15	6-20	6-20	6-1[illegible]	6-10
--material	sand	sand	sand (?) - firm	sand & pebbles	sand & gravel	sand & gravel
--approach obstructions	scattered rocks	neg.	neg	neg	scattered rocks	scattered rocks 1/2 area
Surf - max. height (ft.)	5-8	< 5	> 4	> 4	> 4	> 4
Tidal Range (ft.)	neg. - 3	neg.	neg	< 2	< 2	neg
Coastal Vegetation	cultivation	scattered cultivation	cultivation	mostly rock	scattered cultivation	scattered brush, grass, cultivation
Special Features of Coastal Area						*Crete Corsica, Sardinia, Sicily
GEM Feasibility - see Figure 14						
--% Zone 1	-	70	60	-	-	-
--% Zone 2	60	30	40	70	80	80
--% Zone 3	40	-	-	-	20	20

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TABLE C-9

Mediterranean Coasts of Africa

Country Coastal Climate Zones	Egypt (part) 4D	Libya 2B, 3, 4C, 4D	Tunisia 1A, 2B	Algeria Morocco (part) 1A		
Total Coast Length (mi)	650	1100	400	1400		
Mainland Coast Length (mi)	650	1100	400	1400		
Coastal Terrain	low dunes	scarped and terraced, with dune belt	alternating sandy and rocky with indentations	cliffs backed by alternating Mtns. and plains		
Coastal Stream Valleys - freq.(mi)	Nile Delta	intermittent wadies only	60-100	60-100		
--water width (ft)	>400	>100	>60	>60		
--length (at above width) (mi)	>100	short	?	~100		
--steep banks near coast <15-20 mi	none	few	some	some		
--steep banks inland>15-20 mi	few	some	most	most		
	dikes and levees					
Characteristics of beaches - no.	6 (?)	72	31	138		
--length, % > 2 mi.	?	40	90	10		
--width, % > 50 ft. at H. W.	50	50	90	100		
--width, % > 100 ft. at H. W.	none	none	none	100		
--max. slope, H. W. zone (%)	2-10	3-6	2-10	3-10		
--material	sand, rocks	sand, cobble, seaweed	sand, pebbles	sand, gravel		
--approach obstructions	?	rocks and bars	mud banks	rocks, shoals		
Surf - max. height (ft.)	2-8	3-8	2-8	2-8		
Tidal Range (ft.)	1-5	4	1-6	1-3		
Coastal Vegetation	mostly barren with dunes	scrub	mostly barren	?		
Special Features of Coastal Area	Nile Delta	--	mud flats up to 35 mi. offshore in South	fishing stakes and nets off beaches		
GEM Feasibility - see Figure 14						
--% Zone 1	90	70	-	-		
--% Zone 2	10	10	100	10		
--% Zone 3	-	20	-	90		

TABLE C-10

Red Sea and Indian Ocean Coasts of Africa

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Country Coastal Climate Zones	Egypt (part) 4E	Sudan 4E, 4F	Eritrea, Somaliland's (part)* 4F, 5E	Somaliland's (part)* 5B, 11A	Kenya, Tanganyika 11B	Mozambique 11B
Total Coast Length (mi)	1050	420	1300	1200	975	1430
Mainland Coast Length (mi)	1050	420	1200	1200	800	1430
Coastal Terrain	low sandy dunes backed by Mtns.	sandy coastal plain rising to barren mountains	rocky cliffs backed by rugged mountains	low steep cliffs backed by high dunes	coastal plain backed by steep plateau	wide coastal plain
Coastal Stream Valleys - freq.(mi)	intermittent wadies	intermittent wadies	>50	infrequent, intermittent	30-50	20-400
--water width (ft)	wide near coast	probably wide	>250	?	?	probably wide
--length (at above width) (mi)	<30	<70	<50	?	>80	100+
--steep banks near coast <15-20 mi	1/2	few	none	none	few	few
--steep banks inland>15-20 mi	all	most	some	few	?	few
Characteristics of beaches - no.	37 ?	none	38	18	unknown	14 ?
--length, % > 2 mi.	30	(12 landing places)	50	45	unknown	unknown
--width, % > 50 ft. at H.W.	50		100	50	unknown	unknown
--width, % > 100 ft. at H.W.	none		50	none	unknown	unknown
--max. slope, H.W. zone (%)	2-10		2-10	2-10	unknown	3-6
--material	sand, rocks, coral		sand, pebble	sand, hard mud	unknown	sand, mud
--approach obstructions	reefs & coral up to 5 Mi. out		scattered islets, rocks & reefs	reefs & shoals	unknown	bars & shoals
Surf - max. height (ft.)	1-8	1-5	1-8	3-8	?	3-5
Tidal Range (ft.)	1-5	1-3	3-6	5-9	10-12	11-14
Coastal Vegetation	mostly barren	sparse	sparse, area of lava beds	sparse brush	mangrove, brush	brush
Special Features of Coastal Area	Suez Canal N	occasional steep banks to 20 Ft.	*Fr. Somaliland, and former Br. Somaliland	*former Italian Somaliland	Zanzibar Island	coastal-inland waterway, many lagoons
GEM Feasibility - see Figure 14						
--% Zone 1	-	-	-	80	15	100
--% Zone 2	-	-	90	20	85	-
--% Zone 3	100	100	10	-	-	-

TABLE C-10 (Cont.)

Red Sea and Indian Ocean Coasts of Africa

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Country Coastal Climate Zones	South Africa (part)* 12C, 14A, 15	Madagascar 16A, 17A, 17B, 18A				
Total Coast Length (mi)	1140	2400				
Mainland Coast Length (mi)	1140	2350				
Coastal Terrain	narrow coastal plain, backed by terraces	narrow plain, backed by hills				
Coastal Stream Valleys - freq.(mi)	~50	20-40				
--water width (ft)	?	?				
--length (at above width) (mi)	<100	50-100				
--steep banks near coast <15-20 mi	few	few				
--steep banks inland>15-20 mi	most	some				
Characteristics of beaches - no.	unknown	unknown				
--length, % > 2 mi.	unknown	unknown				
--width, % > 50 ft. at H.W.	unknown	unknown				
--width, % > 100 ft. at H.W.	unknown	unknown				
--max. slope, H.W. zone (%)	unknown	unknown				
--material	unknown	unknown				
--approach obstructions	unknown	unknown				
Surf - max. height (ft.)	?	?				
Tidal Range (ft.)	6	?				
Coastal Vegetation	grass, forest	grass, brush				
Special Features of Coastal Area	*East of Cape Town					
GEM Feasibility - see Figure 14						
--% Zone 1	-	85				
--% Zone 2	50	15				
--% Zone 3	50	-				

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TABLE C-11

Atlantic Coasts of Africa

CONFIDENTIAL

Country Coastal Climate Zones	Morocco 1A, 2A	Spanish Sahara, Fr. W. Africa (part)* 4A, 4B, 5A, 7A, 7B, 7C	Liberia 7C	Fr. W. Africa (part)* 7C, 7D, 7G	Ghana 7E, 7F	Nigeria Cameroons 7B, 8A
Total Coast Length (m.)	600	2020	360	450	335	630
Mainland Coast Length (mi)	600	1970	360	450	335	630
Coastal Terrain	narrow plain, backed by Mtns.	narrow coastal plain	undulating hills, scattered swamps	coastal plain	undulating, with swamps	mostly swamp, intersected by many rivers
Coastal Stream Valleys - freq.(mi)	60-100	intermittent-N 50-100 in S	10-20	30-100	20-80	20-60
--water width (ft)	>60	>500	>250	250-500	60-500	>500
--length (at above width) (mi)	~100	>200	40-80	100-300	50	>200
--steep banks near coast <15-20 mi	some	few	few	few	few	none
--steep banks inland>15-20 mi	Most	some	most	few	some	few
Characteristics of beaches - no.	79	unknown	63	unknown	50	9
--length, % > 2 mi.	45	unknown	85	unknown	65	40
--width, % > 50 ft. at H.W.	100	unknown	50	unknown	70	100
--width, % > 100 ft. at H.W.	90	unknown	none	unknown	30	50
--max. slope, H.W. zone (%)	3-10	unknown	2-10	unknown	2-10	6-10
--material	sand	unknown	sand	unknown	sand, mud	sand, mud
--approach obstructions	bars; reefs, rocks fishnets	unknown	rocks, reefs shoals	unknown	rocks, reefs shoals	scattered shoals and bars
Surf - max. height (ft.)	8-12	?	2-8	?	2-8	2-8
Tidal Range (ft.)	6-9	?	3	?	4	3-7
Coastal Vegetation	dunes with sparse brush	barren-N grass-S	forest, brush, grass	forest, marsh	forest	forest
Special Features of Coastal Area	--	*Now Mauritania Senegal, Gambia, Port Guinea, Guinea Sierra Leone	--	*Now Ivory Coast Togo, Dahomey	--	-
GEM Feasibility - see Figure 14						
--% Zone 1	20	40	-	90	100	90
--% Zone 2	-	25	100	10	-	-
--% Zone 3	80	35	-	-	-	10

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TABLE C-11 (Cont.)

Atlantic Coasts of Africa

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Country Coastal Climate Zones	Fr. Equatorial Africa Area* 8A, 11C	Republic of Congo 11C	Angola 12A, 13A, 13B	S. W. Africa 13B	South Africa (part)* 12B, 13B, 15	
Total Coast Length (mi)	820	24	830	825	400	
Mainland Coast Length (mi)	720	24	830	825	400	
Coastal Terrain	swampy plain	swamp, dissected plain	narrow coastal plain, backed by mountains	sand dunes	mostly rocky, with escarpments	
Coastal Stream Valleys - freq.(mi)	20-50	Congo Delta	20-40	infrequent, intermittent	intermittent-N ~50 in S	
--water width (ft)	wide	>500	?	?	?	
--length (at above width) (mi)	>100	>500	50-100	?	short (<100)	
--steep banks near coast <15-20 mi	few	none	few	few	?	
--steep banks inland>15-20 mi	few	river in gorge ~100 mi. inland	some	?	most	
Characteristics of beaches - no.	unknown	4	unknown	unknown	unknown	
--length, % > 2 mi.	unknown	75	unknown	unknown	unknown	
--width, % > 50 ft. at H.W.	unknown	75	unknown	unknown	unknown	
--width, % > 100 ft. at H.W.	unknown	25	unknown	unknown	unknown	
--max. slope, H.W. zone (%)	unknown	6-10	unknown	unknown	unknown	
--material	unknown	sand	unknown	sand	unknown	
--approach obstructions	unknown	?	unknown	mud flats & bars	unknown	
Surf - max. height (ft.)	?	2-8	?	?	?	
Tidal Range (ft.)	?	2-5	?	?	6	
Coastal Vegetation	forest, swamp	mangrove, forest	forest, brush	none	grass, brush	
Special Features of Coastal Area	*Now Cameroun Rio Muni, Gabon, Congo	--	--	coastal desert	*North of Cape Town	
GEM Feasibility - see Figure 14						
--% Zone 1	-	100	100	30	40	
--% Zone 2	70	-	-	70	50	
--% Zone 3	30	-	-	-	10	

TABLE C-12

Atlantic Coasts of South America

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Country	Colombia (part)	Venezuela	Guiana's*	Brazil	Uraguay	Argentina
Coastal Climate Zones	1, 24	1, 2A, 3A	3B	4A,5A,5B,5C,5D 5E,6A,7,8,9A	9A	9A,10A 11A,12A,13
Total Coast Length (mi)	680	1550	680	4630	360	3000
Mainland Coast Length (mi)	680	1500	680	~4430	360	3000
Coastal Terrain	Swampy lowland	lowlands, with swamps E and around Lake Maracaibo	swampy lowland	swampy lowland, backed by forested hills E, rocky S	grassy lowland, scattered swamps and lagoons	swampy-N, bluffs-S
Coastal Stream Valleys - freq.(mi)	30-50	10-150	30-60	40-100	50	30-100
--water width (ft)	60-250+	60-500	wide	>500	?	60-250+
--length (at above width) (mi)	>50	<100	70-150	>200	50-100	100-200
--steep banks near coast <15-20 mi	none	few	few	few	few	some
--steep banks inland >15-20 mi	few	1/2	few	few	?	most
Characteristics of beaches - no.	~70	unknown	unknown	342	unknown	3 long beaches
--length, % > 2 mi.	50	unknown	unknown	60	unknown	many short beaches
--width, % > 50 ft. at H.W.	60	unknown	unknown	75	unknown	--
--width, % > 100 ft. at H.W.	30	unknown	unknown	40	unknown	--
--max. slope, H.W. zone (%)	2-10	unknown	6-20	3-10	unknown	--
--material	sand	unknown	mud, sand	sand	unknown	mud, sand, rock
--approach obstructions	scattered rocks and reefs	unknown	sand and shell ridges	scattered reefs and shoals	unknown	seaweed-S
Surf - max. height (ft.)	2-8	?	?	2-12	?	Mostly <5
Tidal Range (ft.)	1-7	1-7	7-9	2-17	?	1-31
Coastal Vegetation	forest, marsh	forest, swamp	forest, swamp, cultivation	forest, swamp brush	grass	swamp, grass
Special Features of Coastal Area	--	Lake Maracaibo oil fields	*British, Dutch, French	Amazon Delta, breakers to 30% >8 Ft. in N-winter	--	large swamps NE
GEM Feasibility - see Figure 14						
--% Zone 1	-	90	10	20	100	30
--% Zone 2	90	10	90	75	-	65
--% Zone 3	10	-	-	5	-	5

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TABLE C-13

Pacific Coasts of South America

CONFIDENTIAL

Country Coastal Climate Zones	Colombia (part) 22	Ecuador 21, 22	Peru 18, 19, 20	Chile 13,14,15,16,17,18		
Total Coast Length (mi)	540	570	1400	~6700		
Mainland Coast Length (mi)	540	520	1400	320		
Coastal Terrain	swampy lowland	narrow plain backed by mountains	arid coastal plain backed by mountains	N-arid plain S-narrow plain or rugged hills		
Coastal Stream Valleys - freq.(mi)	50	15-30	20-40	30-100 N fiorded S		
--water width (ft)	>500	60-120	narrow	?		
--length (at above width) (mi)	<80	<100	<40	40-100		
--steep banks near coast <15-20 mi	none	some	some	most		
--steep banks inland>15-20 mi	few	most	most	most		
Characteristics of beaches - no.	~70	unknown	unknown	unknown		
--length, % > 2 mi.	50	(few beaches)	(most of coastal area is barren desert)	unknown		
--width, % > 50 ft. at H. W.	60			unknown		
--width, % > 100 ft. at H. W.	30			unknown		
--max. slope, H. W. zone (%)	2-10			unknown		
--material	sand			unknown		
--approach obstructions	scattered rocks and reefs	scattered bars and reefs		unknown		
Surf - max. height (ft.)	2-8	3-12	3-12+	? (prob. to 12+)		
Tidal Range (ft.)	2-13	5-12	2-6	2-6		
Coastal Vegetation	forest, marsh	grass, forest	barren, except at stream mouths	barren-N grass & brush-S		
Special Features of Coastal Area	--	--	--	southern area extensively fiorded, many islands		
GEM Feasibility - see Figure 14						
--% Zone 1	-	-	-	-		
--% Zone 2	40	100	20	25		
--% Zone 3	60	-	80	75		

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TABLE C-14

Pacific Coasts of North America

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Country Coastal Climate Zones	Alaska (part) (Aleutians) 4A	Alaska (part) (Gulf of Alaska) 6A, 6B	Canada (part) 6B	U.S.A. (part) 6B, 12A, 12B, 13	Mexico (part)* 14A	Mexico (part) 14A, 15A, 17A
Total Coast Length (mi)	1050	1440	~1950	~2200	1930	2575
Mainland Coast Length (mi)	~600	~800	~650	~1900	1880	2175
Coastal Terrain	rocky shores, backed by alt. valleys & Mtns.	Mtns. rising from sea, scattered lowlands	rocky coast, backed by wooded or bare Mtns.	rocky and sandy cliffs, backed by hills	mostly rugged, with ridges & scarps	narrow lowlands backed by Mtns.
Coastal Stream Valleys - freq.(mi)	10-40	mostly fiorded	fiords only	10-40	infrequent, intermittent	30-100
--water width (ft)	>250 braided	>250	(wide)	50-250	?	>250
--length (at above width) (mi)	60-200	short		mostly short	?	<100
--steep banks near coast <15-20 mi	some 1-10	?		some	some	some
--steep banks inland>15-20 mi	most feet vertical	?		most	most	most
Characteristics of beaches - no.	203	35	~250	not tabulated	181	207
--length, % > 2 mi.	25	20	25	not tabulated	60	70
--width, % > 50 ft. at H.W.	50	100	90% no beach at high water, wide at LW	not tabulated	100	70
--width, %> 100 ft. at H.W.	none	none		not tabulated	50	30
--max. slope, H.W. zone (%)	3-10	2-10		not tabulated	2-10	3-10
--material	sand, pebbles	sand, pebble, cobble	sand, mud	sand, clay	sand	sand
--approach obstructions	scattered islets and rocks	rocks & islands	mostly clear	scattered islands	clear-W islets, reefs-E	rocks, reefs, shoals
Surf - max. height (ft.)	2-8	3-8	mostly 3-5	mostly 3-8	1-8	2-8
Tidal Range (ft.)	2-12	9-14	8-23	3-15	2-19	2-17
Coastal Vegetation	forest, brush	forest, brush	forest	forest, grass, cultivation	brush	brush, cultivation
Special Features of Coastal Area	including Alaska Peninsula	incl. Alexander Archipelago	incl. Vancouver & Queen Charlotte Islands	Puget Sound and San Francisco Bay are major indentations	*Baja California Peninsula	--
GEM Feasibility - see Figure 14						
--% Zone 1	10	-	-	10	-	60
--% Zone 2	90	80	20	90	80	40
--% Zone 3	-	20	80	-	20	-

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TABLE C-14 (Cont.)

Pacific Coasts of North America

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Country Coastal Climate Zones	Guatemala (part) El Salvador Nicaragua (part) 17A	Costa Rica (part) Panama (part) 17A, 17B				
Total Coast Length (mi)	600	1200				
Mainland Coast Length (mi)	600	1150				
Coastal Terrain	coastal plain, backed by hills, with swamps	low cliffs & dunes backed by forested hills, with swamps				
Coastal Stream Valleys - freq.(mi)	5-20	10-40				
--water width (ft)	60-250	60-150				
--length (at above width) (mi)	<50	<50				
--steep banks near coast <15-20 mi	few	few				
--steep banks inland>15-20 mi	most	most				
Characteristics of beaches - no.	67	193				
--length, % > 2 mi.	60	10				
--width, % > 50 ft. at H.W.	100	60				
--width, % > 100 ft. at H.W.	50	30				
--max. slope, H.W. zone (%)	2-6	2-10				
--material	sand, silt	sand, mud				
--approach obstructions	mostly clear	scattered rocks & bars				
Surf - max. height (ft.)	5-8	5-8				
Tidal Range (ft.)	6-10	9-16				
Coastal Vegetation	forest, swamp	forest, mangrove				
Special Features of Coastal Area	--	--				
GEM Feasibility - see Figure 14						
--% Zone 1	-	-				
--% Zone 2	100	90				
--% Zone 3	-	10				

TABLE C-15

Arctic Coasts of North America

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Country	Alaska (part)	Canada (part) (Archipelago)*	Canada (part)	Greenland		
Coastal Climate Zones	1A, 4A	1A	1A, 1B, 4D, 4E, 4F	2		
Total Coast Length (mi)	2250	~7800	~5300	~27,000		
Mainland Coast Length (mi)	2200	N.A.	~5200	~26,000		
Coastal Terrain	low bluffs, rolling tundra, scattered marsh	low plain sloping up to rugged E coasts	marshy or frozen lowlands	rugged, fiorded coast with ice lowlands		
Coastal Stream Valleys - freq.(mi)	10-30	W-meandering streams	30-100 fiords in E	fiords only		
--water width (ft)	>250 braided	E-fiorded	?	up to 200 mi. long, with steep shores		
--length (at above width) (mi)	100-200	?	?			
--steep banks near coast <15-20 mi	most | 1-15	?	some			
--steep banks inland>15-20 mi	all | feet vertical	most	most			
Characteristics of beaches - no.	88	unknown	unknown	none		
--length, % > 2 mi.	65	(probably few)	unknown	(160 landing places)		
--width, % > 50 ft. at H.W.	40		unknown			
--width, % > 100 ft. at H.W.	none		unknown			
--max. slope, H.W. zone (%)	3-10		unknown			
--material	sand, shingle		unknown			
--approach obstructions	shoals scattered rocks		unknown			
Surf - max. height (ft.)	5-8	?	?	?		
Tidal Range (ft.)	1-14	1-8	?	6-20 feet		
Coastal Vegetation	tundra	tundra or barren frozen 9 mo. +	tundra	sparse		
Special Features of Coastal Area	ice up to 9 mo. in N; 6 mo. in W	*Baffin Isl., Banks Isl., Victoria Isl., Ellsmere Isl., & many others	incl. Hudson Bay area, frozen 5-8 months	frozen most of year in N		
GEM Feasibility - see Figure 14						
--% Zone 1	50	25	70	-		
--% Zone 2	50	45	20	5		
--% Zone 3	-	30	10	95		
		Incomplete data				

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Atlantic Coasts of North America

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Country	Canada (part)	U.S.A. (part)	Mexico (part)	Br. Honduras, Guatemala (part) Honduras (part)	Nicaragua (part) Costa Rica (part) Panama (part)	C.I.s
Coastal Climate Zones	4B, 4C, 7A, 7B	7B, 8A, 9A, 9B, 9C	15B, 17C, 17D 19A, 20A, 20B, 21	19B	19B	23, 24, 25
Total Coast Length (mi)	~4150	~5400	1610	650	875	2500
Mainland Coast Length (mi)	~2280	4470	1560	650	375	2460
Coastal Terrain	steep rocky shores, backed by hills	ranging from rocky cliffs to swampy lowlands	broad lowland with swamps & lagoons	swampy plain, backed by forested Mtns.	narrow coastal lowland, backed by forested hills with swamps	lowlands with marsh & forest, scattered hills
Coastal Stream Valleys - freq.(mi)	30-60	10-40	30-100	10-30	15-40	15-40
--water width (ft)	?	>250	mostly >250	>250	60-250	60-120
--length (at above width) (mi)	>150	mostly >100	~100	30-60	40-100	<40
--steep banks near coast <15-20 mi	1/2	few	some	few	few	?
--steep banks inland>15-20 mi	most	few	most	1/2	most	?
Characteristics of beaches - no.	unknown	not tabulated	74	51	129	unknown
--length, % > 2 mi.	unknown	not tabulated	65	80	40	unknown
--width, % > 50 ft. at H.W.	unknown	not tabulated	100	50	70	unknown
--width, %> 100 ft. at H.W.	unknown	not tabulated	50	none	30	unknown
--max. slope, H.W. zone (%)	unknown	not tabulated	3-10	1-6	2-10	unknown
--material	unknown	not tabulated	sand	sand	sand	unknown
--approach obstructions	unknown	not tabulated	scattered reefs & shell ridges	barrier reefs & shoals	reefs & shoals obstruct 1/2	unknown
Surf - max. height (ft.)	?	3-8 mostly	5-8	5-12	5-8	?
Tidal Range (ft.)	3-30	2-23	1-3	1-2	1-2	1-2
Coastal Vegetation	forest, grass	cultivation, grass, swamp	forest, marsh	forest, mangrove	forest, mangrove, grass	forest, swamp, cultivation
Special Features of Coastal Area	--	incl. Gulf of Mexico	no streams on Yucatan Peninsula	--	--	--
GEM Feasibility - see Figure 14						
--% Zone 1	10	80	50	25	15	-
--% Zone 2	55	15	50	75	80	100
--% Zone 3	35	5	-	-	5	-

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